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TECHNICAL MANUAL

MODEL 101

HARMONIC ANALYZER SYSTEM

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SECTION I

GENERAL DESCRIPTION

1-1. INTRODUCTION

1-2. Basically a calibration unit for analog (direct record) recorders, the Model 101 consists of an oscillator, an rms voltmeter, a distortion analyzer, and a filter. The unit is capable of measuring (1) output rms signal voltage, (2) percentage of second or third harmonic distortion in the 100 Hz to 1 MHz range, (3) frequency response, and (4) signal-to-noise ratio. Although designed primarily for analog recorders, the 101 is equally effective in measuring the above four quantities in other kinds of instruments.

1-3. OUTSTANDING FEATURES

- The instrument is programmable: all manual operations can be controlled by computer in either BCD or binary code. (Option 1011)
- Auto-harmonic tracking circuitry automatically tracks the unit's internal oscillator and enables either the second or third harmonic distortion in the signal being monitored to be displayed.
- Auto-ranging circuitry permits automatic selection of all ranges, thus eliminating manual switching.
- The unit is extremely easy to use.
- The unit comes in a standard rack size.

1-4. FUNCTIONAL DESCRIPTION

1-5. OSCILLATOR: A voltage controlled 5 to 50 MHz square wave oscillator is digitally divided down to provide an output frequency range of from 100 Hz to 5 MHz. The harmonics of the square wave are removed in a frequency tracking low pass filter, which results in a very low distortion sine wave output. A variable gain, closed loop output amplifier maintains a constant amplitude level regardless of frequency, but dependent upon the setting of the amplitude control.

1-6. RMS VOLTMETER: The voltmeter is an average reading, rms calibrated instrument which includes eight full scale ranges from 3 mV to 10V. Auto-ranging is provided; however, all ranges may be manually selected as well. In addition to measuring input voltage, the voltmeter is used during distortion measurements to indicate percent distortion. Also, by depressing the Osc. out pushbutton, the voltmeter is connected internally to measure the oscillator output amplitude. This pushbutton control eliminates the need to change signal cables during a test to measure the parameter desired.

1-7. WAVE ANALYZER: The voltage controlled oscillator is divided down to obtain not only the fundamental frequency, but also 4.167% offset of the 2nd and 3rd harmonic frequencies. In the harmonic extractor, the distorted input signal is hetrodyned with the offset 2nd or 3rd harmonic frequency. The resulting low frequency output signal equals the 2nd or 3rd harmonic content of the input signal. The high frequency components of the harmonic extractor output are

removed in a frequency tracking low pass filter, and the resultant signal is measured by the RMS voltmeter. To maintain accuracy with input signal amplitude variations, an auto-leveling (AGC) amplifier keeps the input to the harmonic extractor constant. Input signals whose amplitude falls outside the 100 mV to 2V rms dynamic range of this amplifier cause an out of range detector to actuate a front panel indicator light.

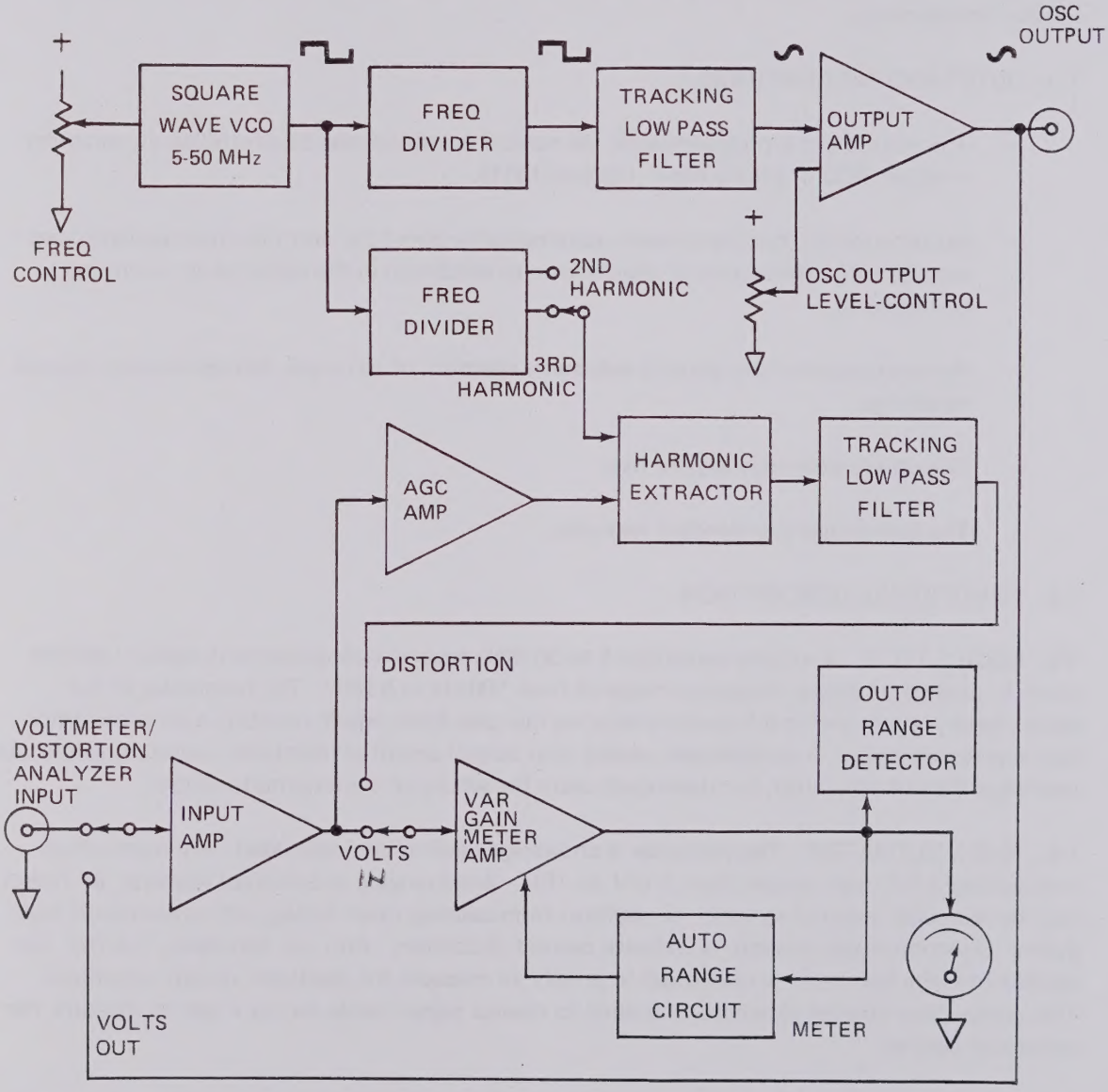

Figure 1-1. Model 101 Block Diagram

1-8. SPECIFICATIONS

RMS VOLTMETER

Ranges: .003, .01, .03, .1, .3, 1.0, 3.0 and 10 Volts with autoranging on all ranges

Accuracy: ±1 db; ±0.3 db at 10 KC

Input Impedance: 1 Meg Ohm.

Frequency Response: ±1.0 db 100 Hz to 5 MHz

DISTORTION ANALYZER

Input Level: 100 mV to 2 Volts rms with automatic input leveling.

Bandwidth: 100 Hz to 1 MHz

Ranges: Second Harmonics – 100%, 30%, 10%, 3%, 1%, 0.3%
Third Harmonics – 100%, 30%, 10%, 3%, 1%, 0.3%
with autoranging on all ranges

Accuracy: ±1 db, 0.3 - 10% ranges; ±3 db, 30% - 100% ranges

SINE WAVE OSCILLATOR

Frequency Range: 100 Hz to 5 MHz

Amplitude: 100 mV to 2 Volts rms

Maximum Loading: 50 ohms

Frequency Leveling: ±0.5 db 100 Hz – 1 MHz

Distortion: 100 Hz to 100 KHz Third Harmonics 0.15% @ 1 V rms
100 KHz to 1 MHz, Third Harmonics 0.2% @ 1V rms

OPTIONS

Option 1011 REMOTE PROGRAMMING: Field installable; allows remote programming of all front panel controls, except AC power on-off and the auto-ranging features of the meter. Logic is TTL compatible (positive logic). Binary coded, 64-step resolution is provided for output amplitude control and for each frequency range; memory is included for these two functions.

Option 1012 SQUARE WAVE OUTPUT: Rear panel switch allows selection of either sine wave or square wave output from the front panel oscillator output BNC connector. Amplitude is continuously variable by oscillator output amplitude control from 200 mV to 4V p-p into 50Ω. Frequency range is 100 Hz-1MHz.

Option 1013 MONITOR OUTPUT: Rear panel BNC connector supplies 0-5 VDC output proportional to front panel meter deflection for strip chart recording or computer processing.

Option 1014 RACK MOUNT BRACKETS.

Option 1015 DC SOURCE: Supplies 0 to ± 3V DC into 1K ohm load. Adjustable via 10 turn control.

Option 1016 AUTOMATIC SIGNAL TO NOISE RATIO: Provides rapid signal to noise ratio measurements with zero db auto leveling of input signal level. Six IRIG Band pass Filters inserted in signal line may be selected to match tape speed.

Option 1017 FRONT/REAR PANEL CONNECTORS.

GENERAL

OPERATING TEMPERATURE: $0^{o}C$ to $+50^{o}C$.

POWER: 115 VAC ±10%; 50-400 Hz; 35 watts. 230 VAC ±10% available on request.

DIMENSIONS: 5¼" H x 17½" W x 12" D (13.34 cm x 44.45 cm x 30.48 cm); optional rack mount brackets available for mounting in standard 19" RETMA rack.

WEIGHT: Approximately 25 lbs; add 5 lbs for shipping.

SECTION II

INSTALLATION

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2-1. INSPECTION AND DAMAGE CLAIMS

2-2. Your 101 was carefully checked before shipment and should be in perfect physical and operating condition. As soon as the instrument arrives, give it a thorough visual inspection and test its performance. If it is damaged or lacking in necessary accessories, file a claim with the carrier; or (if you have insured the shipment separately) with an insurance company.

If it does not meet published specifications, contact the Sales Department of Vu Data Corporation. For more details, see the warranty on the rear cover.

2-3. THREE-CONDUCTOR POWER CABLE

2-4. The 101 comes equipped with a three-conductor power cable. When this cable is plugged into an appropriate receptacle, it grounds the instrument. (The ground wire is the offset pin on the power cable's three-prong connector.) To preserve this grounding capability when operating the 101 from a two-contact outlet, use a three-prong adapter to ground.

2-5. Since the 101 is an all-solid-state instrument, no special cooling is required. Make sure, however, that the instrument is never operated in an ambient temperature greater than $50^{o}C$ ($122^{o}F$).

2-6. RACK/BENCH INSTALLATION

2-7. The 101 is shipped as a bench type instrument. To adapt it for a standard 19" rack mounting, proceed as follows:

1) Remove the two side plates.

2) Unpack rack mounting lugs and hardware (three No. 8/32 x 1/2" slot head screws, each).

3) Position the mounting lugs on each side using the hardware provided. Center the lugs and tighten the screws firmly.

2-8. REPACKAGING FOR SHIPMENT

If the instrument is to be moved at a later date, keep the container in which it was shipped.

SECTION III

OPERATION

3-1. FRONT PANEL CONNECTORS, CONTROLS, AND INDICATORS

3-2. CONNECTORS

IN

This is the BNC signal input to the 101. All signals to be analyzed pass through this connector into the unit. The connector has an input impedance of 1MΩ.

OUT

This is the BNC signal output of the 101. Signals generated in the unit pass through this connector into the instrument under study.

CONTROLS

POWER

The a-c power to the unit is controlled by this on/off button. When the unit is turned on by pressing this button, the meter needle deflects to the right (indicating the presence of noise), and some of the lights in the FULL SCALE VALUE indicator go on.

MODE

There are four MODE selection controls:

- A white button labeled OSC V. which is used only during monitoring of the output level of the 101 oscillator. When this button is pressed, the front panel meter reads the rms voltage of the output signal of the unit.
- A white button labeled V IN which is used during measurements of the output of the instrument being analyzed. When the 101 and this instrument are connected and the V IN button pressed, the meter reads the instrument's rms voltage output.
- A white button labeled 3H which is used during distortion measurements of the output of the instrument under test. When the 101 and this instrument are connected and the 3H button is pressed, the meter reads the percentage of the third harmonic distortion present in the signal being analyzed.
- A white button labeled 2H which is used during measurements of the output of the instrument under test. When the 101 and this instrument are connected and the 2H button is pressed, the meter reads the percentage of the second harmonic distortion present in the signal being analyzed.

FREQUENCY VERNIER

This control allows the operator to continuously adjust the 101 frequency over a decade range.

MULTIPLIER

The five multiplier buttons--labeled 100, 1K, 10K, 100K, and 1M--determine the range value of OSCILLATOR front panel reading. For example, if the 100 button is pressed and the OSCILLATOR reading is 10, the true value of the frequency is 100 x 10 = 1 kHz. (The 1M button should never be used when measuring second or third harmonics.)

AMPLITUDE

This control allows the operator to continuously vary the amplitude of the 101 oscillator output signal within the range 100 mV to 2V rms when the OUT connector is terminated with a 50-ohm load.

METER RANGE

The METER RANGE control has one automatic (AUTO) setting and eight manual (MAN) settings.

- The AUTO setting is used most of the time. With the control in this position, the 101's auto-ranging circuitry is in operation. The FULL SCALE VALUE indicator automatically indicates (1) which of the two bottom scales on the front panel meter is to be read, and (2) the full-scale value of the reading. These full-scale values range from .003V to 10V for signal voltages and from .3% to 100% for percentage harmonic distortion.

- The MAN settings are used whenever the input signal has excessive noise (which could cause the auto-ranging to change ranges frequently). With the control in any of the eight settings, the auto-ranging is inhibited.

3-3. INDICATORS

FRONT PANEL METER

This meter has three scales. The top scale, a dB scale, is used to measure (1) the S/N ratio, and (2) frequency response of the instrument under test or of the 101 output signal. The other two scales are used to monitor rms voltage levels and percentage harmonics.

FULL SCALE VALUE

(a) When the system is in the V MODE, this indicator displays a lighted V and a number that indicates the full-scale value of the range in use. There are eight possible full-scale values——.01V, .1V, 1V, and 10V on the middle scale and .003V, .03V, .3V, and 3V on the bottom scale.
(b) When the system is in the 2H or 3H mode, the indicator displays a lighted % sign, a lighted 2H or 3H, respectively, and a number that corresponds to the full-scale meter range in percent of the second or third harmonic. There are six possible full-scale percentages——1%, 10%, and 100% for the middle scale, and .3%, 3%, and 30% for the bottom scale.

3-4. OSCILLATOR DIAL

The frequency of the internal test oscillator signal is read off this indicator. The true value of the frequency is determined by multiplying the setting of the OSCILLATOR cursor by the value of the MULTIPLIER button that is pressed.

3-5. BACK PANEL CONTROLS AND INDICATORS

3-6. OPTIONAL CONTROLS

MAN/REMOTE (101 only) (Option No. 1011)

Sliding this switch to the REMOTE position turns on the REMOTE light on the front panel and disables all front panel controls except the POWER switch.

CONNECTORS (NOTE: All connectors listed below are optional)

SQ. WAVE OUTPUT (Option No. 1012)

This BNC connector supplies a square wave signal to the equipment under test at an amplitude that is variable between 200 mV and 5 volts peak-to-peak at a frequency determined by the product of the FREQUENCY VERNIER DIAL setting and MULTIPLIER settings. A front panel pushbutton switch selects sine or square wave output.

MONITOR OUTPUT (Option No. 1013)

This BNC connector supplies a d-c voltage of 0-5V proportional to the front panel meter deflection.

DC VOLTAGE SOURCE (Option No. 1015)	DC voltage, 0 to −3 volts, into 1K-ohm load variable control by means of 10 turn front panel control.
BAND PASS FILTER (Option No. 1016)	Six Band Pass Active Filters per IRIG Standards 106-69 Table XIII, selectable by front panel switch.
REAR PANEL CONNECTORS (Option No. 1017)	These rear panel BNC connectors are in parallel with the connectors on the front panel.

3-7. OPERATION

3-8 Measurement of RMS Voltage

1) Connect the 101 OUT to the tape recorder signal input connector (record) and the 101 IN to the tape recorder signal output connector (reproduce).
2) Turn on the power to the 101 by pressing the POWER button.
3) Press the V OUT button of the MODE control and put the METER RANGE in the AUTO position.
4) Using the FREQUENCY VERNIER control, the MULTIPLIER control, and the AMPLITUDE control, set the 101 frequency and the amplitude to the values desired.
5) Press the V IN button of the MODE control and note characters that light up on the FULL SCALE VALUE indicator. The number indicates which of the meter scales to read and the full-scale value of this scale.
6) Read the output level of the recorder on the front panel meter.

3-9. Measurement of Second or Third Harmonic Distortion

1) Connect the 101 OUT to the tape recorder signal input connector and the 101 IN to the tape recorder output connector.
2) Turn on the power to the 101 by pressing POWER button.
3) Press the V OUT button and put the METER RANGE in the AUTO position.
4) Using the FREQUENCY VERNIER, the MULTIPLIER, and the AMPLITUDE controls, set the 101 frequency and amplitude to the desired values. Do not use the 1M MULTIPLIER button when measuring second or third harmonics.
5) Turn on the tape recorder and operate in the RECORD mode.
6) Press the V IN button of the MODE control and note the characters that light up on the FULL SCALE VALUE indicator. The number indicates which of the two meter scales to read and the full-scale value of this scale.
7) Read the output level of the recorder on the meter. (This output level must be within the 100mV – 2V rms operating range of the 101. If it is not, the "OR" (out of range) on the front panel will light.)
8) Press the 2H or 3H button and note the characters that light up on the FULL SCALE VALUE indicator. The number indicates which of the two bottom meter scales to read and the full-scale value of this scale.
9) Read the percentage of second or third harmonic distortion present in the signal being analyzed.

3-10. Measurement of Signal-to-Noise (S/N) Ratio

1) Connect the 101 OUT to the tape recorder signal input connector and the 101 IN to the tape recorder output connector.
2) Turn on the power to the 101 by pressing the POWER button.
3) Press the V OUT button of the MODE control and put the METER RANGE in the AUTO position.
4) Using the FREQUENCY VERNIER control and the MULTIPLIER control, select the desired frequency.
5) Adjust the AMPLITUDE control for cn oscillator output of 1V RMS.
6) Turn on the recorder and run the tape. (Set the proper filter bandwidth.)
7) Press the S/N –db button of the MODE control.
8) Press the S/N Read button after the meter has read 0 db.
9) Read the S/N ratio on the Meter db scale.

> **NOTE**
>
> Improper noise Filter Bandwidth selection will cause erroneous signal to noise ratios.

3-11. Measurement of the Frequency Response of the Tape Recorder

1) Connect the 101 OUT to the tape recorder signal input connector and the 101 IN to the tape recorder output.
2) Turn on the power to the 101 by pressing the POWER button.
3) Press the V OUT button of the MODE control and put the METER RANGE in the AUTO position.
4) Using the FREQUENCY VERNIER control and the MULTIPLIER control, select the desired frequency.
5) Adjust the AMPLITUDE control so that the meter reading is 0 dB when the full-scale value of the middle scale is 1V.
6) Turn on the recorder and run the tape.
7) Press the V IN button of the MODE control.
8) Adjust the output level on the tape recorder so that the meter reads 0 dB when the full-scale value of the middle scale is 1V.
9) Sweep the FREQUENCY VERNIER over the desired range while monitoring the output level on the meter.

SECTION IV

THEORY OF OPERATION

4-1. CIRCUIT DESCRIPTIONS

4-2. SECOND SHAPER OF TEST OSCILLATOR (BOARD A1)

4-3. Bd A1 consists of the second 3-pole shaper filter of the test oscillator. This filter is identical to the first shaper on Bd A2 in circuitry but is operated at a lower amplitude level——65 mV rms versus 300 mV on Bd A2. This difference of about −13 dB represents the insertion loss of the active filter combined with the losses due to operation on the slope of the corner frequency (which is approximately the frequency of the test oscillator).

4-4. To cover the wide range of input frequencies, the filter corner frequency is made tunable by means of three tracking photoresistors——P1, P2, and P3. Since the tracking is confined to a conservative one-decade range, the photoresistors can track within a few percent over the decade band. Capacitive elements C9-C18 and C20-C24 using active elements to preserve programmability and to cover decade ranges. The ratios of three capacitive arms of the filter determine the roll-off characteristics of the low-pass filter (LPF); in this design a 0.1 dB Chebyschev response is used.

4-5. Within a decade band, tuning of the filter is completely automatic——that is, no external control other than the test signal itself is used to optimize filtering. This self-tracking operation is achieved with a constant-output-level control by varying the photoresistor resistance until a fixed loss of −13 dB is held. As a result, the filter roll-off or corner frequency is just below the input test frequency. Under these conditions, about −26 dB suppression of the third harmonic (the most prominent harmonic) is maintained throughout the decade band. Since the input test frequency is prefiltered to about 1.8% of the maximum third harmonic, the output frequency has a residual third harmonic of less than 0.1%.

Q11 and Q12 are the Darlington active elements of the LPF. The other transistors from Q3 to Q20 are active switches that change the capacitive element of the filter for each decade. Q3-Q10 act as switches to ground for capacitors C9-C17 when band control voltage on input pins 9 through 12 is positive +4 volts.

4-6. There are five bands: Band a (1-5 MHz), Band b (.1-1 MHz), Band c (10-100 kHz), Band d (1-10 kHz), and Band e (.1-1 kHz). Except for Band a, the band is selected by applying +4 volts to one of the four inputs (pins 9 through 12). The inputs that are not enabled are quiescent at −17 volts. For Band a operation, all input lines are quiescent negative, and the hardwired capacitors C3, C16, and C18 determine the corner frequency.

4-7. C19-C22, the series arm feedback capacitors, are switched via a unique low-loss active switch. For example, in Band b Q17 goes into saturation to bias emitter-follower Q13. Feedback capacitor C19 is placed in the amplifier loop with less than one-ohm series impedance owing to the emitter-follower buffering. To switch out of the loop without introducing significant loading on the desired feedback capacitor, Q17 is cut off, leaving zero bias on Q13 and providing a near open circuit condition on the driving side of C19. This open circuit condition is realized for all signal amplitudes on C19 less than the emitter-base breakdown (about 5 volts).

4-8. Q1 and Q2 furnish a gain of 5 to amplify the LPF output to 300 mV at Test Point 2. In addition to driving its own autotracking control circuit, this amplifier generates the test oscillator reference signal for open loop frequency control on Bd A4 LPF and also feeds the final power amplifier and level control circuits thru emitter follower Q21.

4-9. Automatic frequency tracking of the active filter is controlled by full wave AC to DC converter U-1, differential filter amplifier U-2, and photo cell lamp driver Q22. Operation is as follows: Assume the output of the LPF decreases from its normal output level at TP-2. The rectified signals at TP-3 and the anode of diode CR6 will decrease in amplitude causing the output of U-2 to go more positive due to its 180 degree phase inversion. This higher voltage increases LP-1 light intensity which reduces the resistance of photoresistors P1, P2, and P3. Their lowered resistance moves the filter cutoff frequency higher thus reducing the filter attenuation until the LPF output returns to its normal level.

4-10. The above operation automatically corrects the LPF output as the frequency is varied over each decade band range.

4-11. CLOCK SYSTEM (BOARD A3)

In this clock system, a decade variable clock is divided down by two divider chains to produce the fundamental test frequency and the offset harmonic mixing frequencies. Since the division is performed digitally, the test and mixing frequencies are in an exact relationship to one another. For example, to obtain a 1 MHz test frequency, the 50 MHz clock frequency is divided by 50; to generate the third harmonic mixing frequency, the clock frequency is divided by 16 to yield 3.125 MHz or 4.167% offset from the third harmonic (3 MHz); to generate the second harmonic mixing frequency, the clock frequency is divided by 24 to give 2.083 MHz or a 4.167% offset from the second harmonic (2 MHz).

4-12. The operator can program the divider chain for the harmonic offset for the second or third harmonic by pressing the 2H or 3H button on the front panel. To provide decade test frequencies, the operator can continuously vary the clock frequency from 50 MHz to 5 MHz by means of a front panel control. Because of the digital division, harmonic test frequencies offset by precisely 4.167% from the harmonic are simultaneously available. And finally, the operator can divide the clock frequency by factors of 10 (decade ranging) by means of the five MULTIPLIER buttons on the front panel.

4-13. Since the test frequency is generated by digital division, the output waveform is not sinusoidal. To achieve a resultant low-distortion sinusoidal signal, it is necessary to minimize filtering requirements, and this is done by dividing by two immediately prior to filtering. The result is a square wave with a minimum of harmonic distortion. This feature, combined with the fact that the largest possible divisor is used to obtain a low (4.167%) offset harmonic frequency for both second and third harmonics, constrains the clock frequency to an upper limit of 50 MHz. A low percentage offset harmonic mixing frequency is needed to facilitate filtering of mixing products in the low-pass filter (Bd A4).

4-14. Transistors Q1-Q8 constitute the decade variable clock. The basic multivibrator is Q5, which is in an emitter-coupled voltage feedback configuration. C5, in series with VVC diode CR4, is the timing capacitor that determines the clock frequency. R8 and R13 permit the circuit to achieve a full decade tunability from 5 MHz to 50 MHz with nearly linear tuning characteristics of 3.2 MHz per volt. Q1 varies the collector voltage swing of Q5 and at the same time varies the bias of varactor CR4. Upper frequency tuning is controlled completely by CR4. Intermediate tuning is governed by the collector swing of Q5; and lower frequency tuning is controlled almost entirely by the current in the emitter of Q6. Voltage-to-current converter transistor Q2 removes a precise amount of current from Q4 via current source Q6. The output of the clock is buffered by Q7 and Q8 and shaped by Q9 for TTL logic compatibility.

4-15. A pulse-averaging frequency discriminator, consisting of operational amplifier A11 and constant-area pulser Q18 and Q19, controls the exact frequency of the decade variable clock, establishes the closed loop linearity, and ensures the accuracy of the test frequency. Pulser Q18 and Q19 is operated at 0.001 of the clock frequencies in order to reduce bandwidth problems. Before it is fed into the pulser, the clock output is divided by decade dividers U2, U3, and U4. The d-c voltage at pin 21——via R68, R21, and R27——is current-summed against the current pulses from R30 to produce a virtual null across the inputs of integrator U11. There is nulling only when the

loop is closed, and all elements of the loop are operated in their linear regions. Under these conditions, the output voltage of U11 is somewhere between −18V and +15V, the outputs of the two supply voltages.

4-16. In order to isolate problems in the frequency-control loop, a test switch is provided to break the closed loop and to permit well-defined gain in U11 for the purpose of testing the open-loop limits of the clock. With the control voltage set to maximum (+5V), the clock frequency will be 52-53 MHz. With the control voltage set to minimum (+.450V), the clock frequency will be approxmately 4.5 MHz. Another linearity check that can be made in the open-loop position is a monitoring of the width of the output pulse. The pulse width will remain unchanged throughout the clock frequency range.

4-17. In Band a, FET switch Q16 shorts out partial-summing resistor R27, and as a result a control voltage of about 2.5 volts is sufficient to produce a 50 MHz clock output. The test oscillator output in this band varies from 1 MHz to 5 MHz, while the clock varies from 10 MHz to 50 MHz. In all other bands, the test frequency varies by a decade across the dial, while the clock frequency varies from 5 MHz to 50 MHz. The control voltage of 2.5V coordinates the frequency dial indication with the actual clock frequency.

4-18. MECL dividers U5, U6, and U7 form a fast divide-by-5 stage that accept 50 MHz frequencies in Bands a and b via fast gates——transistors Q10 and Q11 and gate drivers Q14 and Q15. In the other three bands, the inputs are from dividers U2-U4 via gates U9 and buffer Q12. Differential output drivers, Q23 and Q24, feed Test Oscillator Filter (Bd A2) where additional division and shaping prior to generation of the test frequency occurs.

4-19. TTL dividers U8 and U10 divide down the clock to generate the harmonic test frequencies. Gates U9A and U9B modify the division ratio from 2 to 3 for second or third harmonic measurement, respectively. Note that TTL divides down the 50 MHz clock, whereas in the divide-by-five stage, MECL devices are required. The difference between TTL and MECL dividers is that TTL circuitry can divide at 50 MHz only in the divide-by-two mode. The output of U10 is divided by two through U8 before going to the Harmonic Extractor (Bd A5). This division by two ensuring that the mixer in the Harmonic Extractor receives a square wave modulating signal for least spurious operation.

4-28. INPUT CONDITIONING CIRCUIT (BOARD A6) Use other description. For ref only

Two separate amplifier systems are provided in Bd A6 to meet the different needs of the voltmeter (V mode) and harmonic analyzer (2H or 3H mode). In the V mode, an accurate preamplifier (Q4, Q5, and Q6) preceded by a programmable 10-to-1 attenuator Q8 handles the three decade plus input signal range. In the 2H or 3H mode, a preamplifier (Q10, Q11, and Q12) with a gain of 11 followed by an auto-leveling control circuit, allows constant output (300 mV) to drive the Harmonic Extractor Circuit. Both preamplifiers must maintain a flat frequency response from 10 Hz to 5 MHz. The output of the V mode preamplifier is fed to a precision FET Q7 prior to driving the Auto-Ranging Circuit. In the 2H or 3H mode, this FET opens the V mode preamplifier path and permits the resultant harmonic extractor products to drive the Auto-Ranging Circuit through Q17. Q26 completes the path for the signal to noise (S/N) option.

4-29. Q1, the FET buffer, and transistors Q2 and Q3, the unity-gain feedback amplifier, convert the 1 MΩ input impedance to a negligibly low impedance for driving the V mode and 2H or 3H mode preamplifiers. The frequency-compensated attenuation network (C1, C2, C3, R2, etc.) at the input, limits the input level in the V mode to maintain gain linearity at the upper frequencies. In addition, the large resistive input provides complete protection against excessive input levels. Gain error due to loading of the FET output is eliminated by unity-gain bootstrap feedback via capacitor C6.

4-30. The preamplifier in the harmonic analyzer mode is included in a high-gain auto-leveling loop to maintain a constant 300 mV rms output over a 20-to-1 input amplitude range while at the same time introducing a minimum amount of distortion. The input to this preamplifier is held to a constant 28 mV by photocell resistor P1. Control for P1 is derived by amplifying the X11 output (transistors Q13 and Q14) to about 1.7V rms and half-wave rectified by transistor Q15. Operational amplifier U1 and U2 average the rectified level to drive lamp driver transistor Q16. Closed loop operation is as follows: Assume the output level exceeds the normal level of 300 mV. After averaging, the output of integrator U1 and U2 goes in a negative direction, increasing the lamp intensity. The photocell resistance decreases, the X11 amplifier input level is reduced, and the output level is restored to its nominal 300 mV level. For the S/N option, switch Q27 opens when the S/N read button is depressed.

4-31. As long as the photocell lamp voltage can be varied, the leveling can be achieved. Input voltages that are too high (> 2V) or too low (< 100 mV) are detected by comparing the lamp voltage at the limiting conditions——transistor Q20 detects the lamp off (or LOW) condition, and transistor Q19 detects the lamp fully on (or HIGH) condition. In the V mode, lamp driver is cut off by Q22 since the indicators are for 2H, 3H, or S/N measurements only.

4-32. Preamplifier (Q4, Q5, and Q6) is preceded by attenuator R15 and R19 and switch Q8. The X10 attenuation is active only when the input voltage exceeds 1V rms. For inputs equal to or less than this value, transistor switch Q8 is cut off for zero attenuation. In the V mode, FET switch Q7 switches the signal to the meter unit. In the 2H or 3H mode, Q17 switches the harmonic products to the meter unit, and Q18 provides the drive to the FET switches and opens up transistor switch Q7 to reduce the unwanted outputs of the V mode amplifier. For the S/N mode. Q7 and Q17 are off when Q26 is on.

4-33. AUTO-RANGING CIRCUIT, METER AMPLIFIER AND DRIVER CIRCUIT (BOARD A7)

All measurements from 1 mV to 1.0V rms are scaled through wide band, decade-gain programmable amplifiers to a level sufficient to drive an a-c to d-c converter whose output is connected to the display meter. For inputs greater than 1.0V, the amplifiers are programmed to the next lowest decade of gain; for inputs less than 10 mV, the amplifiers are returned to their highest gain configuration; for input levels less than 30% of full scale, the meter drive limiting resistor R50 is bypassed by Q5 to achieve full scale for a 30% input. All the foregoing gain changes take place in the Meter Amplifier and Driver Circuit only——the rest of the circuits in the 101 are not affected. Without an input to the Auto-Ranging Circuit, all amplifiers are in their highest gain position (3 mV full scale), and the internal amplifier noise determines the minimum quiescent meter reading.

4-34. In all servo feedback systems, it is necessary to establish enough hysteresis to eliminate hunting under ordinary transient conditions during ranging and to prevent severe amplitude fluctuations in the measured signal. The latter condition can be corrected by switching to fixed-gain operation (the MAN position of METER RANGE switch). Level-determining Schmitt triggers U5, U6, and U7 have about 5% hysteresis to minimize the need for hunting. After the Schmitt trigger detects an over-range level, a gated multivibrator (Q6, Q7, and Q8) is set in motion. If the over-range condition persists for 300 msec, down ranging begins; if the over-range condition still persists after 800 msec in the new gain setting, the next gain position is automatically selected; and if over-range is beyond the gain-ranging capabilities of the unit, the gain-determining counters U8, which are operated in a four-step cyclical configuration are locked up in their lowest gain state. A single RC integration applied to the input of the level detectors provides the necessary transient suppression during ranging. Momentary overshoots which may trip the level detectors will not cause ranging since the gated multivibrator must receive a steady (300 msec) over-range command before triggering the gain-determining counters.

4-35. In the circuits being described, there are two wide band gain-of-10 amplifiers. One is formed by amplifier U1, and the other by amplifier U2. The gain of the two amplifiers is adjusted by variable resistors R14 and R28.

4-36. Each of the amplifiers is gain-programmed when the solid-state switches (transistors Q2 and Q4) return the R7 and R21 to ground. When this occurs, the gain of the amplifiers is not changed, but rather the input is attenuated by a factor of ten. The overall effect is a gain of 1 to 10 depending on whether Q2 is saturated or off. Since the two amplifiers are in cascade, their combined gain can range from 1 to 100, and since in the V mode the preamplifier on the input of Bd A6 can be gain-altered by another factor of 10, an over-all dynamic range of 1000 to 1 is achievable in the V mode. As a consequence, in this mode inputs from a few millivolts to 10 V rms can be accomodated.

With the auto-ranging correctly operating, the input to the a-c to d-c converter (U3, U4) has a range of 1.0 V rms full scale to 80 mV rms. U3, CR8, CR9 provide precision diodes to yield accurate full-wave rectification. Linearity over the usable range is maintained by the large negative feedback introduced by R32 and R35.

4-37. U4, a d-c amplifier, furnishes the gain which results in a 5.00 Vdc output for full-scale meter deflection (when the 30% local gain ranging is not enabled) when the input to the converter is 1.00 V rms.

4-38. All ranging determinations are made by three operational amplifiers (U5, U6 and U7) operated as Schmitt triggers and referenced to three precision d-c levels that are produced by a supply-dependent precision current source (transistor Q9). Over-range amplifier U5 is referenced to 5.10 volts; under-range amplifier U7 is referenced to .425 volt; and the 30% range amplifier U6 is referenced to 1.45 volts. For reliable operation, calibration pot R55 is set for 5.10 volts at amplifier U5. The remaining voltages of the divider chain are not critical within their design limits. Improper setting of R55 will result in excessive ranging in the vicinity of full-scale or in no ranging (lockup) in any band.

4-39. Under normal conditions with in-range inputs, the output of U7 is negative with transistor Q10 cut off (positive at collector) and the reset lines of U8 not enabled. Also the output of U5 is positive, with gated multivibrator (Q6, Q7, and Q8) cut off. The output of U6 may be positive or negative depending on whether the input is above or below the 30% level. Transistor Q5 is operated in the inverted mode switch configuration—-positive base input saturates the output to within a millivolt of zero.

4-40. For over-range inputs, U5 goes negative to start a negative discharge of C31, which starts the timing of the gated multivibrator (Q7 and Q6 emitter feedback). When the multivibrator recovers, buffer Q8 emits a negative-going pulse to advance U8 to the next lowest gain setting. Quad gate U9 decodes the two-bit counter to one of four lines to actuate the programmable gain devices. These four lines do not directly drive the gain devices, but first go to the Executive Programming Circuit (Bd A8) where they are gated by the auto-manual switching logic. Bd A8 also uses these lines to synthesize the lamp indicator drive signals.

4-41. EXECUTIVE PROGRAMMING CIRCUIT (BOARD A8)

Four gain lines come out of the Auto-Ranging Circuit: three are positive and one is negative. The positive lines are used for logic control; the negative line selects the desired gain. To override these automatic controls, the operator can set the METER RANGE front panel to one of nine manual positions. Quad gates A1 serve as disable gates for the auto gain lines. Quad gates A2 are OR-gates that accept the input from the AUTO or MAN switch position.

It can be seen in the table below that full-scale designations are different for the same gain setting in the three modes of operation.

POSITION	V	2H OR 3H	S/N	GAIN
1	Auto	Auto	Auto	Any
2	10V	100%	0 db	1
3	3V	30%	−20 db	3
4	1V	10%	Out of Range	10
5	.3V	3%	Out of Range	30
6	.1V	1%	Out of Range	100
7	.03V	.3%	Out of Range	300
8	.01V	Out of Range	Out of Range	1000
9	.003V	Out of Range	Out of Range	3000

To coordinate the 100-to-1 offset in scale between the V mode and the 2H or 3H mode, transistors Q3, 4, 5, 6, 8, 9, and 10 perform the mode selection to drive lamp encoder transistors Q15-19. Inputs to these transistors are designated .01 to 10 in four decade steps. The outputs of Q3, 4, 5, 6, 8, 9, 10 are OR'ed where needed to enable one of these decade steps.

4-42. Transistors Q20, 23, 25, 27, 29 drive the 100% full-scale lamps as shown in the lamp identification box in the schematic diagram. Transistors Q21, 24, 26, 28, 30 drive the 30% full-scale lamps. For 30% selection a "1" appears on pin 7, which saturates Q36 to cutoff Q20, 23, 25, 27, 29 via diodes to their bases. For 100% selection Q35 is saturated and the 30% drivers are not enabled.

4-43. In the signal to noise mode, Q31 is saturated to indicate 0 db. For −20 db, Q22 is turned on. Q7 and Q41 lock out ranges not needed for the signal to noise mode.

4-49. POWER AMPLIFIER (BOARD A16)

4-50. This board contains a remote-gain wideband power amplifier. The input signal from Bd A1 goes to the base of Q1 where it is attenuated by fixed resistor R2 and photocell P1. The photocell amplitude controlled signal is applied to a power output operational amplifier consisting of U1, Q3, and Q4. This amplifier has a gain of 5.9. The output is connected to the front panel oscillator output connector via a coax cable.

4-51. The amplifier output also goes to the input of a precision AC to DC converter consisting of Q5, Q6, Q7 and Q8. This converter is identical to the one located on Bd A6. Its output is fed to integrating amplifier U2 which drives Q9 to control the intensity of LP1. A zero to 5V dc signal is applied through A16 board pin 2 and fed to the non-inverted input of operational amplifier U2.

4-52. The input voltage at pin 2 is divided by two precision resistors, R33 and R35. When the d-c voltage at U2 Pin 2 is lower in level than the voltage at Pin 3, the output at Pin 1 goes high, turning off Q9. This decreases the voltage on LP1, allowing P1 and P2 to achieve their maximum resistance, which in turn permits more signal to be passed and amplified. As a result, the output of the amplifier increases, and the output of the a-c to d-c converter also increases. This continues until the d-c level of Pins 2 and 5 are equal.

4-53. REMOTE LOGIC (BOARD A12)

This board provides the switching circuitry to disconnect the front panel controls and enable the remote digital control lines to (1) select the frequency band and measurement mode and (2) fine select the test frequency and test amplitude. In the latter two cases, the remote signals are 6-bit binary commands which are converted to analog voltages for fine selections of frequency and amplitude.

4-54. Multiple selector A7 selects four of the eight input lines as determined by the logic state of the selector control command on Pin 9. A logic level '1' enables all four of the $\underline{A}$ lines, thus allowing the remote control lines to operate; a logic '0' enables the $\underline{B}$ lines, which permits the front panel push buttons to operate. Note that the logic notations indicate that the complement of $\underline{A}$ is selected, whereas the $\underline{B}$ inputs aren't complemented.

4-55. For fine frequency and amplitude selection, the binary-coded digital control lines are first stored in latching buffers A1, A2, and A3. These latches follow or store the input levels, depending on the state of the latch control command input on Pins 4 and 13 off the latches. A positive level on the control line permits the latches to follow the input. The latch will store the input state at the moment of the last negative-going transition of the control line. If the remote source is a computer, the usual mode of operation is to set up the data lines for about 200 ns prior to a Data Ready Command, which strobes in the data.

4-56. The output of each set of six digital controls goes to current-switching transistors Q1 through Q6. Each switch controls the resistor return voltage so that a weighted current is switched in or switched out of the summing mode at the inverting input to operational amplifier A4. The resistors are related in a binary manner and generate 64 discrete levels at the output of operational amplifier A5. The outputs of both A4 and A5 go to the remote selector switch mounted on the rear panel (S2).

4-57. In the remote position, the digital-to-analog converter replaces the front panel potentiometers that control the amplitude and frequency of the test oscillator. Since the pot levels are between 0.42 volt and 5.2 volts, the digital-to-analog output voltages are adjusted to these same voltage levels. The lower level (0.42V) is established by returning the non-inverting input of the operational amplifier to 0.42 volt. The upper level is established by taking the product of the value of feedback resistor R26 (or 31) and the sum of all binary currents to be equal to 5.2V. Since the 64 discrete levels are developed between these two limits, the level of each step is $(5.2 - 0.42)/64$.

> **NOTE**
>
> Assembly A12 is installed into the J9 connector when remote programming is required (Option 1011).

4-58. SQUARE WAVE OUTPUT, OPTION 1012

4-59. This option provides selection of either a square wave or sine wave output from the oscillator. Since the sine wave is derived from a square wave (with the harmonics removed), both waveforms are contained within the 101B. The option routes the square wave signal from pin 15 of Board A2 to the ~~front~~ rear panel ~~pushbutton~~ selector switch and after sine or square selection to the output power amplifier Board A16. The high frequency response of the power output amplifier degrades the shape of the square wave above 1 mega Hertz.

4-60. DC MONITOR OUTPUT OPTION 1013

4-61. This option provides a rear panel BNC connector which supplies a zero to +5V dc full scale voltage proportional to the front panel meter indication. It is used to drive recorders, DVM's or other remote indicators. The output signal is taken from pin 15 of Board A7. It has a 100Ω series limiting resistor.

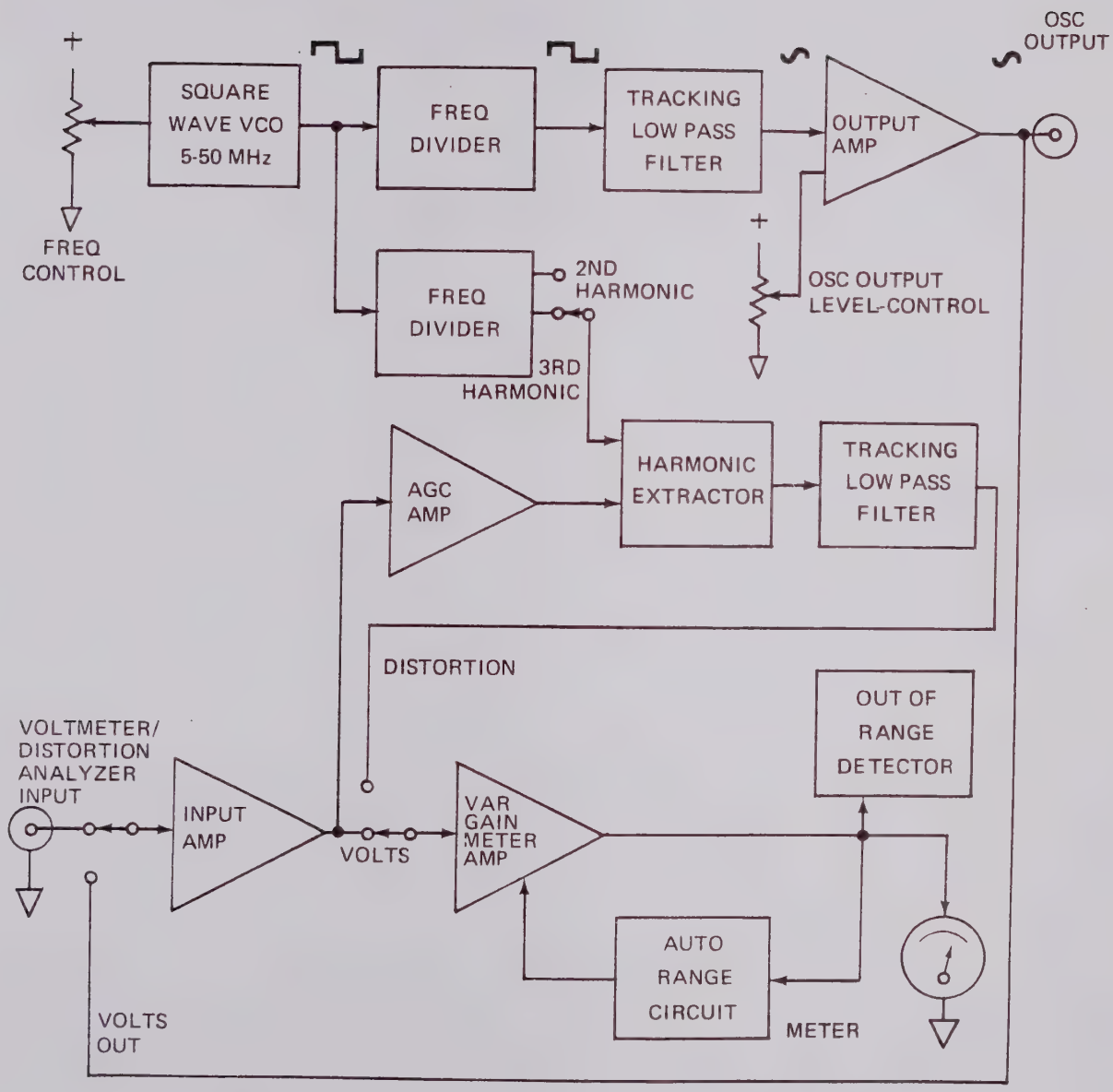

Figure 4-2. Model 101 Block Diagram

SECTION V

MAINTENANCE

5-1 TROUBLESHOOTING

No Lights or Meter Indication

1. Insure POWER ON button is depressed

2. Check amp fuse located on Rear Panel; if necessary, replace it, if good, go to Step No. 3.

3. Remove top cover, measure +18 Vdc −18 Vdc and +5.2 Vdc test points located on Mother Board. If all are good, go to Step No. 4. If +18 Vdc is bad, go to Step No. 5. If −18 Vdc is bad, go to Step No. 6. If +5.2 Vdc is bad, go to Step No. 7.

4. Replace A8 Board.

5. Check voltage drop across R1 on A10 should be less than 500 mV. If it is less, check CR2, CR4 and A1 on A10 PCB or Q1 on Rear Panel. If it is more, the problem is elsewhere in the System**

6. Check voltage drop across R16 on A10 should be less than 500 mV. If it is less, check CR1, CR3, Q3, Q4, Q5 on A10 or Q6 on Rear Panel. If it is more, the problem is elsewhere in the System**

7. Check voltage drop across R8 on A10 should be less than 330 mV. If it is less, check A2 on PCB A10 and Q2 on Rear Panel. If it is more, the problem is elsewhere in the System**

**To determine the problem area, turn off power and remove PCB's one at a time, each time applying power to unit until the defective board is located. Replacing those which have no effect as you proceed.

TABLE 5-1

Voltmeter Inoperative

1. Apply a 1KHz sine wave at 1 volt ±2% RMS to IN Connector and depress V IN button.
2. Set Meter Range Switch to Man 1V position.
3. Remove top cover.
4. Measure signal level at Pin 7 of Bd A6 for 100 mV RMS ±2%. If bad, replace Bd A6. If good, go to Step No. 5.
5. Check TP5 on Bd A7. Should read 5 Vdc ±2%. If bad, replace A7. If good, go to Step No. 6.
6. Check for signal at Meter M1. If it is not present, check components on Mother Board. If it is present, go to Step No. 7.
7. Replace Meter M1 and calibrate (R76 Mother Board) for full scale reading.

TABLE 5-2

Wave Analyzer Inoperative

1. Check voltmeter mode is functioning (See Voltmeter Inoperative).
2. Apply a 1V rms sine wave from an external source to the IN Connector.
3. Adjust internal oscillator to 10 on Frequency Dial and depress 10K multiplier. Using a frequency counter, insure 101 Output to be 100.0 KHz.
4. Adjust external oscillator for 3X this frequency (300.0 KHz) monitor with frequency counter.
5. Depress 3H button and set Meter Range switch to Man 100% position.
6. Meter M1 should display 100% Distortion ±10%. If not, go to Step No. 7.
7. Remove top cover and place A4 Board on an Extender Card.
8. Connect a-c RMS Voltmeter to Pin 21 and GND select 0 dB range on RMS voltmeter.
9. Apply external oscillator to Pin 7 and GND, adjust external oscillator to 16 KHz and adjust amplitude until 0 dB on external a-c voltmeter is obtained.
10. Adjust external oscillator to 24 KHz. Do not change level.
11. External a-c voltmeter should indicate approximately –6 dB to –8 dB.
12. If not, then A4 should be changed. A5 will also require calibration due to some interaction.
13. If readings are good, then A5 should be changed.

TABLE 5-3

Oscillator Inoperative

1. Remove top cover and place A16 Board on Extender Card. Set Frequency Dial to "1" and check Pin 3 A16 for 300 mV RMS. If good, change A16. If bad, go to Step No. 2.

2. Place A1 Board on Extender Card and check Pin No. 21 for 165 mV RMS. If good, change A1 Board. If bad, go to Step No. 3.

3. Place A2 Board in Extender Card and using an oscilloscope check Pin No. 2 for 1.8V p.p. If good, change A2 Board. If bad, change A3 Board.

TABLE 5-4

CALIBRATION PROCEDURES

5-1. System calibration should be done in the following sequence:
A10, A3, A2, A1, A16, A6, A7, A4, A5

5-2. TEST PROCEDURE, POWER SUPPLY BOARD A10

EQUIPMENT REQUIRED:

1. DVM H/P 3430A or Equivalent.

5-3. CALIBRATION PROCEDURE:

1. Monitoring +18 Vdc test point on the Mother Board adjust Potentiometer R3 for 18.00V ± 10 mV.

2. Monitoring −18 Vdc test point on the Mother Board adjust Potentiometer R13 for 18.00Vdc ± 10 mV.

3. Monitoring +5.2 Vdc test point on the Mother Board adjust Potentiometer R10 for 5.20 Vdc ± 10 mV.

CALIBRATION PROCEDURES (Continued)

5-4. TEST PROCEDURE VC0-50 MHz CLOCK BOARD A3

5-5. EQUIPMENT REQUIRED:

1. 10 MHz Counter H/P 5325A or equivalent.
2. DVM H/P 3430A or equivalent.

5-6. CALIBRATION PROCEDURE:

1. Adjust Frequency Vernier to read '1' on Dial.
2. Connect DVM to arm of Frequency Vernier Pot and adjust Lo-cal Pot R5 on Mother Board for .50 Vdc. (R5 FIG BELOW VERNIER POT)
3. Adjust Frequency Vernier to read '10' on Dial.
4. Adjust Hi-cal Pot R6 on Mother Board for 5.0 Vdc.
5. Place Test/Normal switch on A3 Board in Test Position. 16.0 VDC
6. Monitor, with a DVM the Emitter of Q1.
7. Adjust Frequency Vernier for 16.0 Vdc.
8. Connect Frequency Counter TP2.
9. Adjust Potentiometer R8 until Frequency is 53.0 KHz.
10. Adjust Frequency Vernier for reading of 1.40 Vdc.
11. Calibrate Potentiometer R13 until frequency is 5.0 KHz. Some interaction will be noted between R8 and R13, Steps 9, 10, 11 may have to be repeated.
12. Place Test/Normal switch in Normal position.
13. Adjust Frequency Dial Cursor to read '1'.
14. Using counter monitor frequency Output at Out Connector (Front Panel).
15. Adjust Pot R28 for 1X Range Output.
16. Set Frequency Vernier to 8.0 on Dial.
17. Adjust Pot R38 for 8X Range Output.
18. Select 1M Band and set Frequency Vernier to 5.0 on Dial.
19. Adjust Pot R68 for 5.00 MHz Output.

CALIBRATION PROCEDURES (Continued)

5-7. TEST OSCILLATOR FILTER BOARD A2

5-8. EQUIPMENT REQUIRED:

1. Oscilloscope – Vu-data Model 910A, or equivalent.
2. RMS Voltmeter – H/P 400E1, or equivalent.

5-9. CALIBRATION PROCEDURE:

1. Select 10K Band.
2. Set Frequency Dial Pointer to "1".
3. Attach RMS voltmeter to Pin 21 of A2.
4. Adjust R70 on A2 for 300 mV RMS ±5 mV at Pin 21.
5. Attach scope to TP3, Bd A2, and DC couple input of scope.
6. Adjust R60 on A2 such that the flat base line portion of the rectified waveform equals zero volts.
7. Recheck for 300 mV RMS at Pin 3 and readjust R70 if necessary.

CALIBRATION PROCEDURES (Continued)

5-10. TEST OSCILLATOR OUTPUT FILTER BOARD A1

5-11. EQUIPMENT REQUIRED:

1. Oscilloscope – Vu-data Model 910A or equivalent.
2. RMS Voltmeter – H/P 400 E1, or equivalent.

5-12. CALIBRATION PROCEDURE:

1. Select 10K Band.
2. Set Frequency Dial Pointer to "1".
3. Attach RMS voltmeter to Pin 3 of A1.
4. Adjust R55 on A1 for 300 mV ±5 mV at Pin 3.
5. Attach scope to TP3 and DC couple input.
6. Adjust R48 on A1 such that the flat base line portion of the rectified waveform corresponds to zero volts.
7. Recheck for 300 mV RMS at Pin 3 and readjust R55 if necessary.

CALIBRATION PROCEDURES (Continued)

5-13. POWER AMPLIFIER BOARD A16

5-14. EQUIPMENT REQUIRED:

1. DVM H/P 3430A or equivalent.
2. RMS Voltmeter H/P 400 E1, or equivalent.

5-15. CALIBRATION PROCEDURE:

1. Select 10K Multiplier on Front Panel, Freq. Dial to 1, sine wave.
2. Connect DVM to output BNC.
3. Adjust amplitude control Front Panel for minimum (ccw).
4. Calibrate Potentiometer R15 on A16 for 0V dc ±10 mV at BNC output connector.
5. Remove DVM and connect RMS voltmeter to output BNC.
6. Rotate amplitude control on Front Panel to maximum.
7. Adjust R30 for 2.0V RMS minimum.

CALIBRATION PROCEDURES (Continued)

5-16. INPUT AMPLIFIER BOARD A6

5-17. EQUIPMENT REQUIRED:

1. Signal Generator Wavetek 155 or equivalent.
2. A-c RMS Voltmeter H/P 400 E1. or equivalent.
3. Oscilloscope Vu-data Model 910A or equivalent.

5-18. CALIBRATION PROCEDURES: Use other procedure → For ref only

1. Using External Oscillator apply to 101 IN Connector a 1 KHz 5 Vp-p square wave.
2. Observe with oscilloscope at test point 1 and adjust C2 on A6 for (least tilt) on square wave.
3. With External Oscillator set at 10 KHz vary amplitude from 100 mV to 2.0 volts RMS and adjust R64 for a constant Output at Pin No. 2 of 300 mV RMS.
4. Proceed to A7 Calibration Instructions.
5. Set function to V, with shorted input observe ranging to .003V full-scale range and note that preamplifier noise level is less than 1.2 mV as indicated on Meter M1.
6. Check accuracy of 10V range, apply 10V RMS sine wave at 10 KHz. Adjust R19 for 10V on meter.

*7. Select S/N mode.

*8. Connect output of 101 oscillator to Input BNC connector.

*9. Set Osc. amplitude for approximately 1V RMS.

*10. Adjust R79 so that meter reads 0 db.

*11. Push S/N Read button and note that meter reads below minus 40 db.

*For S/N option 1016 only.

→

CALIBRATION PROCEDURES (Continued)

5-19. AUTO RANGING BOARD A7

5-20. EQUIPMENT REQUIRED:

1. DVM H/P 3430A or equivalent.
2. Signal Generator H/P 651B or equivalent.
3. A-c RMS Voltmeter H/P 400 E1. or equivalent.
4. Oscilloscope Vu-data PS910A or equivalent.

5-21. CALIBRATION PROCEDURES:

1. Check that meter M1 is mechanically zeroed with power off before proceeding further.
2. Depress white V pushbutton.
3. Manually select 0.01V range.
4. Apply 10 KHz sine wave to IN connector on front panel and set amplitude to 0.01V RMS at TP1 Bd 7.
5. Adjust R15 on A7 for 0.1V RMS at TP2.
6. Connect DVM to TP5.
7. Connect oscilloscope to TP4.
8. Adjust R38 on A7 until flat portion of waveform equals zero volts with scope DC coupled.
9. Remove scope from TP4.
10. Adjust R28 on A7 until DVM reads 5.00V dc.
11. Adjust R4 on Mother Board (below meter) for 1 KΩ between A7. (Pins 19 and 20).
12. Connect DVM to TP7.
13. Adjust R55 on A7 until DVM reads +5.10 Vdc.
14. Adjust external oscillator amplitude to 0.1V RMS at TP1 and manually select the 0.1V range.
15. Adjust R22 on A7 until DVM reads 5.00 Vdc at TP5.
16. Manually select the 1.0V range and adjust the external oscillator amplitude to 1.0V at TP1 on Bd A7.
17. Adjust R6 on A7 until DVM reads 5.00 Vdc at TP5.
18. Set level on external oscillator to 1.00V RMS at 10Kc.
19. Adjust R27 on A6 Board such that TP1 on Board A7 measures 1.00V RMS.
20. Manually select 3V range and adjust oscillator to 3.0V.
21. Adjust R71 for 3.0V indication on the meter.

SECTION VI

PARTS LIST & DRAWINGS

TABLE 6-1 TEST OSCILLATOR MODEL 101 A1

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
A1		Printed Circuit Board	1013005a	1-20038
		CAPACITORS		
C 1	K2R2E35	Tant. 2.2uf 35V ±20%	05397	6-75225
C 2	DM15FD101J03	D.M. 100pf 500V ±5%	04062	6-19101
C 3	DM15FD101J03	D.M. 100pf 500V ±5%	04062	6-19101
C 4	UK50-104	C.D. .1uf 50V +80%-20%	71590	6-24104
C 5	UK50-104	C.D. .1uf 50V +80%-20%	71590	6-24104
C 6	UK50-104	C.D. .1uf 50V +80%-20%	71590	6-24104
C 7	UK50-104	C.D. .1uf 50V +80%-20%	71590	6-24104
C 8	DM15FD821J03	D.M. 820pf 500V ±5%	04062	6-19821
C 9	DM15FD121J03	D.M. 120pf 500V ±5%	04062	6-19121
C10	XP2A152J	Mylar .0015uf ±5%	IMB	6-46152
C11	XP2A103J	Mylar .01uf ±5%	IMB	6-46103
C12	XP2A153J	Mylar .015uf ±5%	IMB	6-46153
C13	XP2A104J	Mylar 0.1uf ±5%	IMB	6-46104
C14	XP2A154J	Mylar 0.15uf ±5%	IMB	6-46154
C15	K1E35	Tant. 1.0uf 35V ±20%	05397	6-75105
C16	DM15FD220J03	D.M. 22pf 500V ±5%	04062	6-19220
C17	T360C106M035AS	Tant. 10uf 35V ±20%	05397	6-75106
C18	DM15FD221J03	D.M. 220pf 500V ±5%	04062	6-19221
C19	XP2A222J	Mylar .0022uf ±5%	IMB	6-46222
C20	XP2A223J	Mylar .022uf ±5%	IMB	6-46223
C21	XP2A224J	Mylar 0.22uf ±5%	IMB	6-46224
C22	K2R2E35	Tant. 22uf 35V ±20%	05397	6-75225
C23	T360C106M035AS	Tant. 10uf 35V ±20%	05397	6-75106
C24	K33E20	Tant. 33uf 20V ±20%	05397	6-74336
C25	T360C106M035AS	Tant. 10uf 35V ±20%	05397	6-75106
C26	K33E20	Tant. 33uf 20V ±20%	05397	6-74336
C27	K1E35	Tant. 1.0uf 35V ±20%	05397	6-75105
C28	5HKS-S10	C.D. .01uf +60%-40%	71590	6-28103
C29	UK50-104	C.D. .1uf 50V +80%-20%	71590	6-24104
C30	UK50-104	C.D. .1uf 50V +80%-20%	71590	6-24104
C31	K1E35	Tant. 1.0uf 35V ±20%	05397	6-75105
C32	DM15FD15J03	D.M. 150pf 500V ±5%	04062	6-19151
C33	K1E35	Tant. 1.0uf 35V ±20%	05397	6-75105
C34	UK50-104	C.D. .1uf 50V +80%-20%	71590	6-24104
C35	UK50-104	C.D. .1uf 50V +80%-20%	71590	6-24104
C36	UK50-104	C.D. .1uf 50V +80%-20%	71590	6-24104
C37	UK50-104	C.D. .1uf 50V +80%-20%	71590	6-24104
C38	UK50-104	C.D. .1uf 50V +80%-20%	71590	6-24104
C39	K33E20	Tant. 33uf 20V ±20%	05397	6-74336
C40	K330E6	Tant. 330uf 6V ±20%	05397	6-71337
C41	K33E20	Tant. 33uf 20V ±20%	05397	6-74336
C42	DM15FD050J03	D.M. 5pf 500V ±0.5pf	04062	6-19050

TABLE 6-1 (continued) A1

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
		CHOKES		
L1-3	1537-76	100uf R.F.	DELEVAN	5-90007
		DIODES		
CR1-7	IN914	Signal IN914	JEDEC	3-10914
		TRANSISTORS		
Q 1	2N4275	NPN 2N4275	07263	3-24275
Q 2	2N4258	PNP 2N4258	07263	3-24528
Q 3	2N4275	NPN 2N4275	07263	3-24275
Q 4	2N4275	NPN 2N4275	07263	3-24275
Q 5	2N4275	NPN 2N4275	07263	3-24275
Q 6	2N4275	NPN 2N4275	07263	3-24275
Q 7	2N4275	NPN 2N4275	07263	3-24275
Q 8	2N4275	NPN 2N4275	07263	3-24275
Q 9	2N4275	NPN 2N4275	07263	3-24275
Q10	2N4275	NPN 2N4275	07263	3-24275
Q11	2N4275	NPN 2N4275	07263	3-24275
Q12	2N4275	NPN 2N4275	07263	3-24275
Q13	2N4275	NPN 2N4275	07263	3-24275
Q14	2N4275	NPN 2N4275	07263	3-24275
Q15	2N4275	NPN 2N4275	07263	3-24275
Q16	2N4275	NPN 2N4275	07263	3-24275
Q17	2N2484	NPN 2N2484	07263	3-22484
Q18	2N2484	NPN 2N2484	07263	3-22484
Q19	2N2484	NPN 2N2484	07263	3-22484
Q20	2N2484	NPN 2N2484	07263	3-22484
Q21	2N3694	NPN 2N3694	07263	3-23694
Q22	2N4275	NPN 2N4275	07263	3-24275
Q23	2N4275	NPN 2N4275	07263	3-24275
		INTEGRATED CIRCUITS		
U 1	LM318	Amp LM318	NAT'L	3-30318
U 2	LM301A	Amp LM301	NAT'L	3-30301
		RESISTORS		
R 1	RC07GF470J	C.C. 47ohm 1/4W 5%	01121	5-10470
R 2	RC07GF821J	C.C. 820ohm 1/4W 5%	01121	5-10821
R 3	RC07GF681J	C.C. 680ohm 1/4W 5%	01121	5-10681
R 4	RC07GF273J	C.C. 2.7ohm 1/4W 5%	01121	5-10273
R 5	RC07GF391J	C.C. 390ohm 1/4W 5%	01121	5-10391
R 6	RC07GF151J	C.C. 150ohm 1/4W 5%	01121	5-10151
R 7	RC07GF391J	C.C. 390ohm 1/4W 5%	01121	5-10391
R 8	RC07GF391J	C.C. 390ohm 1/4W 5%	01121	5-10391
R 9	RC07GF391J	C.C. 390ohm 1/4W 5%	01121	5-10391
R10	RC07GF391J	C.C. 390ohm 1/4W 5%	01121	5-10391
R11	RC07GF391J	C.C. 390ohm 1/4W 5%	01121	5-10391
R12	RC07GF391J	C.C. 390ohm 1/4W 5%	01121	5-10391
R13	RC07GF391J	C.C. 390ohm 1/4W 5%	01121	5-10391

TABLE 6-1 (continued) A1

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
R14	RC07GF151J	C.C. 150ohm 1/4W 5%	01121	5-10151
R15	RC07GF151J	C.C. 150ohm 1/4W 5%	01121	5-10151
R16	RC07GF471J	C.C. 470ohm 1/4W 5%	01121	5-10471
R17	RC07GF221J	C.C. 220ohm 1/4W 5%	01121	5-10221
R18	RC07GF183J	C.C. 18Kohm 1/4W 5%	01121	5-10183
R19	RC07GF182J	C.C. 1.8Kohm 1/4W 5%	01121	5-10182
R20	RC07GF220J	C.C. 22ohm 1/4W 5%	01121	5-10220
R21	RC07GF473J	C.C. 47Kohm 1/4W 5%	01121	5-10473
R22	RC07GF473J	C.C. 47Kohm 1/4W 5%	01121	5-10473
R23	RC07GF473J	C.C. 47Kohm 1/4W 5%	01121	5-10473
R24	RC07GF473J	C.C. 47Kohm 1/4W 5%	01121	5-10473
R25	RC07GF470J	C.C. 47ohm 1/4W 5%	01121	5-10470
R26	RC07GF273J	C.C. 2.7ohm 1/4W 5%	01121	5-10273
R27	RC07GF273J	C.C. 2.7ohm 1/4W 5%	01121	5-10273
R28	RC07GF273J	C.C. 2.7ohm 1/4W 5%	01121	5-10273
R29	RC07GF273J	C.C. 2.7ohm 1/4W 5%	01121	5-10273
R30	RC07GF470J	C.C. 47ohm 1/4W 5%	01121	5-10470
R31	RC07GF101J	C.C. 100ohm 1/4W 5%	01121	5-10101
R32	RC07GF472J	C.C. 4.7K 1/4W 5%	01121	5-10472
R33	RN55D4530F	M.F. 453ohm 1/8W 1%	91637	5-51158
R34	RC07GF123J	C.C. 12Kohm 1/4W 5%	01121	5-10123
R35	RN55D1821F	M.F. 1.82Kohm 1/8W 1%	91637	5-51218
R36	RC07GF221J	C.C. 220ohm 1/4W 5%	01121	5-10221
R37	RC07GF222J	C.C. 2.2Kohm 1/4W 5%	01121	5-10222
R38	RC07GF100J	C.C. 10ohm 1/4W 5%	01121	5-10100
R39	RC07GF182J	C.C. 1.8Kohm 1/4W 5%	01121	5-10182
R40	RC07GF100J	C.C. 10ohm 1/4W 5%	01121	5-10100
R41	RN55D4751F	M.F. 4.75Kohm 1/8W 1%	91637	5-51268
R42	RC07GF562J	C.C. 5.6Kohm 1/4W 5%	01121	5-10562
R43	RC07GF122J	C.C. 1.2Kohm 1/4W 5%	01121	5-10122
R44	RC07GF333J	C.C. 33Kohm 1/4W 5%	01121	5-10333
R45	RC07GF333J	C.C. 33Kohm 1/4W 5%	01121	5-10333
R46	RC07GF331J	C.C. 330ohm 1/4W 5%	01121	5-10331
R47	RC07GF331J	C.C. 330ohm 1/4W 5%	01121	5-10331
R48	72XWR5K	Var. 5K	BECKMAN	5-73502
R49	RN55D3321F	M.F. 3.32K 1/8W 1%	91637	5-51243
R50	RN55D3321F	M.F. 3.32K 1/8W 1%	91637	5-51243
R51	RC07GF473J	C.C. 47Kohm 1/4W 5%	01121	5-10473
R52	RC07GF473J	C.C. 47Kohm 1/4W 5%	01121	5-10473
R53	RC07GF104J	C.C. 100Kohm 1/4W 5%	01121	5-10104
R54	RC07GF562J	C.C. 5.6Kohm 1/4W 5%	01121	5-10562
R55	72XWR10K	Var. 10K	BECKMAN	5-73103
R56	RC07GF331J	C.C. 330ohm 1/4W 5%	01121	5-10331
R57	RC07GF331J	C.C. 330ohm 1/4W 5%	01121	5-10331
R58	RC07GF394J	C.C. 390K 1/4W 5%	01121	5-10394
R59	RC07GF561J	C.C. 560ohm 1/4W 5%	01121	5-10561

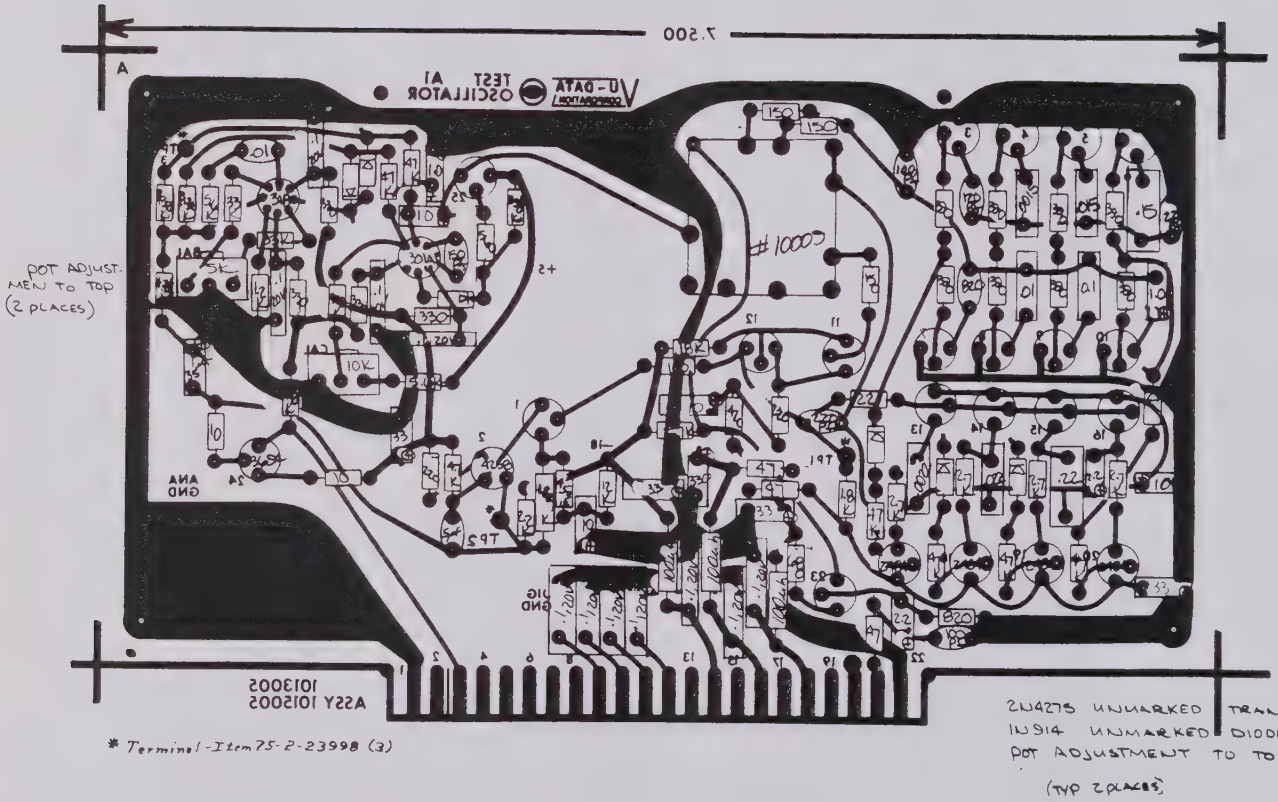

Fig. 6-1 Overlay Board A-1 Parts Location

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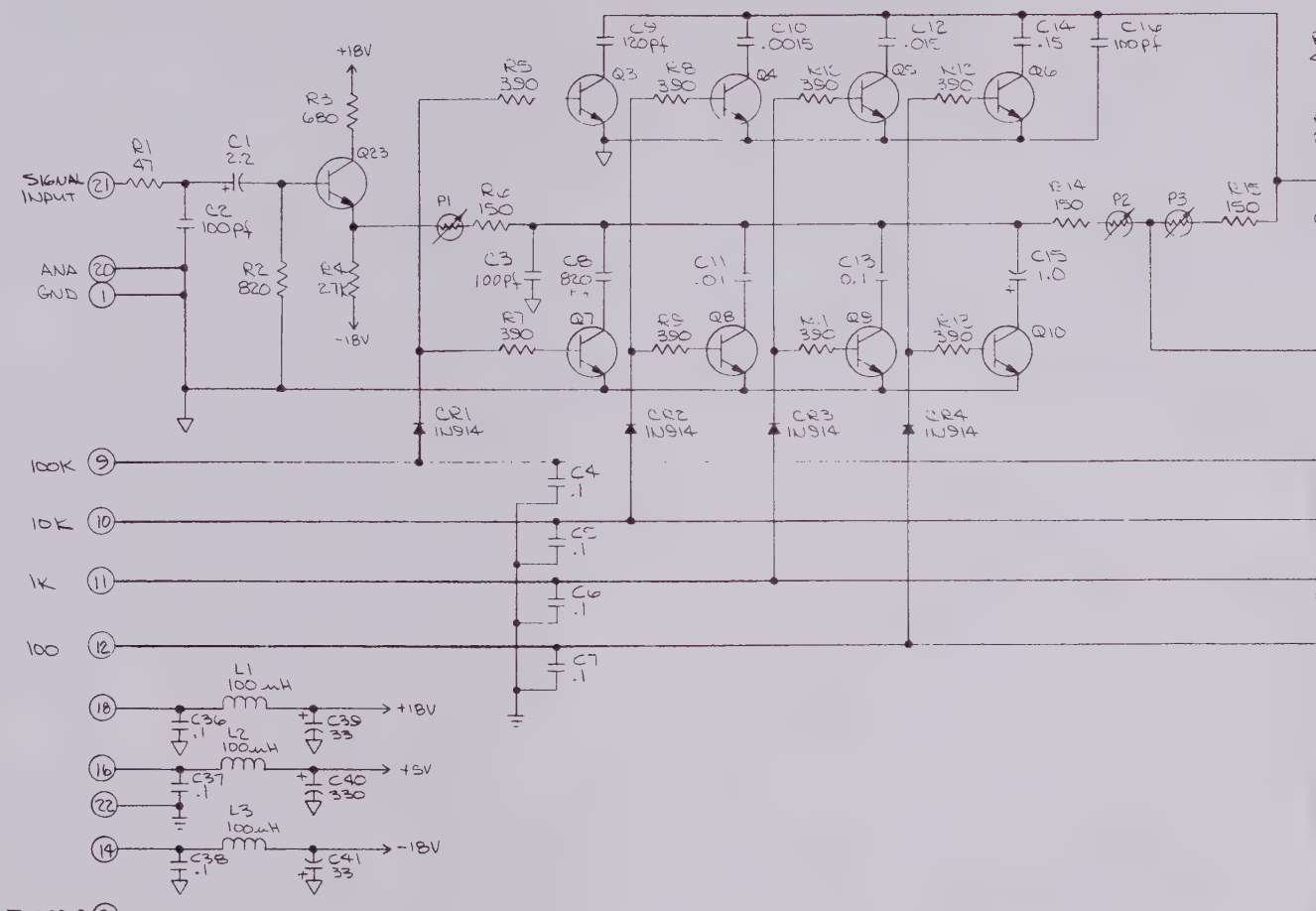
VU-DATA CORPORATION



LAST	R	CR	C	Q	TP	U	L	P	LP
USED	59	7	42	23	3	2	3	3	1

6. P1,2,3, AND LP1 ARE CONTAINED IN SUB-ASSY # 1015017
5. ⏚ DENOTES DIGITAL GND
4. ⏚ DENOTES ANALOG GND
3. ALL TRANSISTORS 2N4275
2. ALL CAPACITORS IN MF
1. ALL RESISTORS 1/4W. 5%. OHMS

NOTES: UNLESS OTHERWISE SPECIFIED

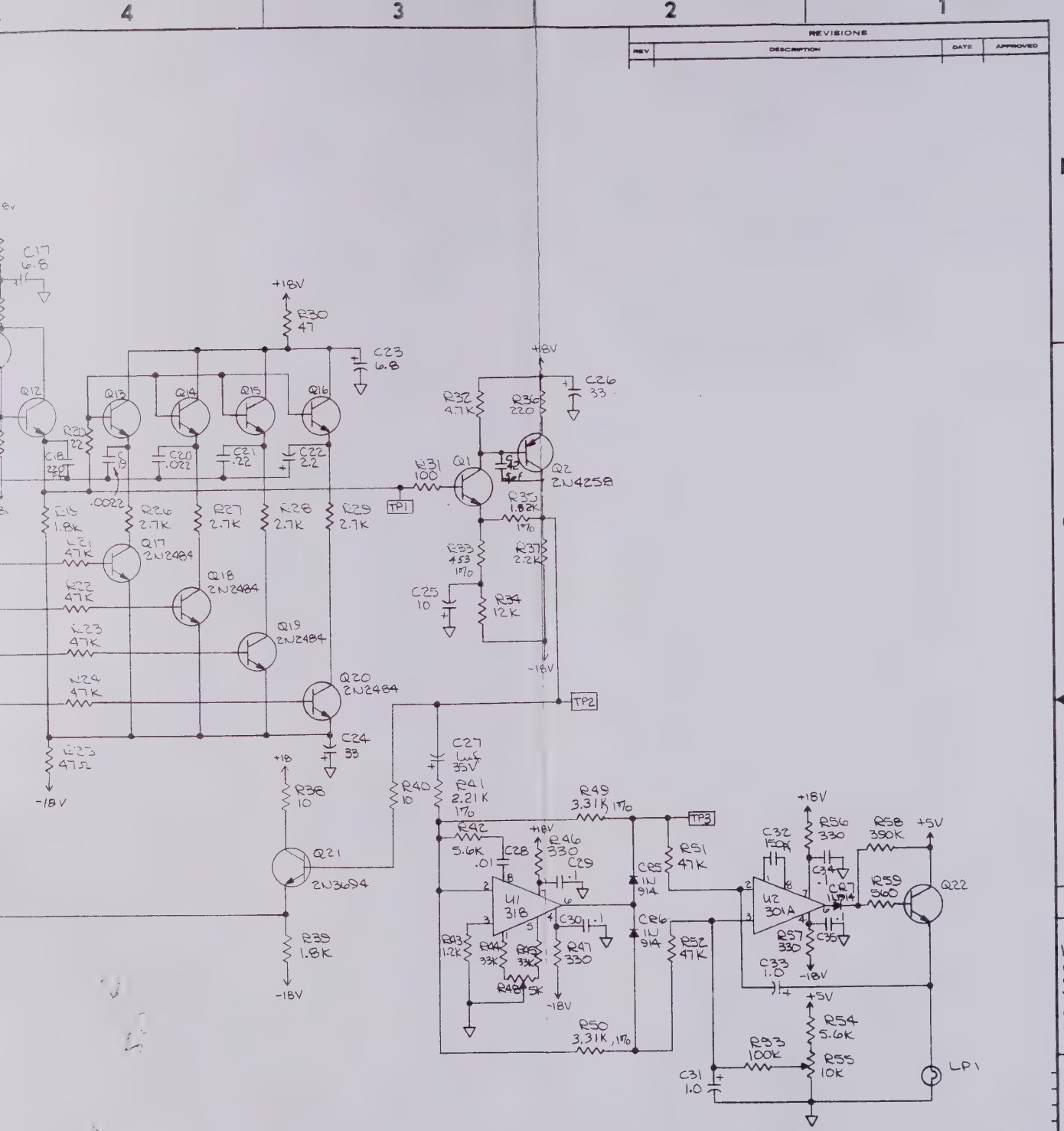

REVISIONS
REV
DESCRIPTION
DATE
APPROVED
+18V
-18V
+5V
Q12
Q13
Q14
Q15
Q16
Q17 2N2484
Q18 2N2484
Q19 2N2484
Q20 2N2484
Q21 2N3604
Q1
Q2 2N4258
U1 318
U2 301A
R30 47
R31 100
R32 4.7K
R33 453 1%
R34 12K
R35 1.82K 1%
R36 220
R37 2.2K
R38 10
R39 1.8K
R40 10
R41 2.21K 1%
R42 5.6K
R43 1.2K
R44 33K
R45 33K
R46 330
R47 330
R48 5K
R49 3.31K 1%
R50 3.31K 1%
R51 47K
R52 47K
R53 100K
R54 5.6K
R55 10K
R56 330
R57 330
R58 390K
R59 560
C23 6.8
C24 33
C25 10
C26 33
C27 1μF 35V
C28 .01
C29 .1
C30 .1
C31 1.0
C32 150pf
C33 1.0
C34 .1
C35 .1
CR5 1N 914
CR6 1N 914
TP1
TP2
TP3
LP1
ITEM NO
QTY REQD
DESCRIPTION
SCHEM DES
VU-DATA PN
MIL OR VENDOR PN
CODE OR SPEC NO
LIST OF MATERIAL
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ±
DECIMALS .X ±.050
.XX ±.030
.XXX ±.010
ANGLES °
SURFACE FINISH ✓
MATERIAL
FINISH
CONTRACT NO.
DRAWN Chung 9-20-72
CHECKED
ENGINEER 11-15-72
APPROVED
APPROVED
CUSTOMER APPROVAL
RELEASE
VU-DATA CORPORATION
SAN DIEGO, CALIFORNIA
SCHEMATIC - TEST OSCILLATOR OUTPUT A1
SIZE D
CODE IDENT NO. 34160
DRAWING NO. 1011005
REV
SCALE NONE
SHEET 1 OF 1
PART NO
QTY REQD
NEXT ASSEMBLY
USED ON
1015005
APPLICATION
1011005

TABLE 6-2 PARTS LIST, TEST OSCILLATOR, ASSEMBLY A2

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
A2	1013006	Printed Circuit Board	34160	1-20039
		CAPACITORS		
C 1	K330E6	Tant., 330uf, 6V	05397	6-71337
C 2	DM15FD220J03	D.M., 22pf, 500V, 5%	04062	6-19220
C 3	DM15FD101J03	D.M., 100pf, 500V, 5%	04062	6-19101
C 4	DM15FD121J03	D.M., 120pf, 500V, 5%	04062	6-19121
C 5	DM15FD821J03	D.M., 820pf, 500V, 5%	04062	6-19821
C 6	XP2A152J	Mylar, .0015uf, 5%	IMB	6-46152
C 7	XP2A103J	Mylar, .01uf, 5%	IMB	6-46103
C 8	XP2A153J	Mylar, .015uf, 5%	IMB	6-46153
C 9	XP2A104J	Mylar, .1uf, 5%	IMB	6-46104
C10	XP2A154J	Mylar, .15uf, 5%	IMB	6-46154
C11	K1E35	Tant., 1uf, 35V	05397	6-75105
C12	DM15FD220J03	D.M., 22pf, 500V, 5%	04062	6-19220
C13	DM15FD101J03	D.M., 100pf, 500V, 5%	04062	6-19101
C14	K10E35	Tant., 10uf, 35V	05397	6-75106
C15	DM15FD221J03	D.M., 220pf, 500V, 5%	04062	6-19221
C16	XP2A222J	Mylar, .0022uf, 5%	IMB	6-46222
C17	XP2A223J	Mylar, .022uf, 5%	IMB	6-46223
C18	XP2A224J	Mylar, .22uf, 5%	IMB	6-46224
C19	K2R2E35	Tant., 2.2uf, 35V	05397	6-75225
C20	K10E35	Tant., 10uf, 35V	05397	6-75106
C21	K33E20	Tant., 33uf, 20V	05397	6-74336
C22	K10E35	Tant., 10uf, 35V	05397	6-75106
C23	UK20-104	C.D., .1uf, 20V	71596	6-24104
C24	UK20-104	C.D., .1uf, 20V	71596	6-24104
C25	UK20-104	C.D., .1uf, 20V	71596	6-24104
C26	UK20-104	C.D., .1uf, 20V	71596	6-24104
C27	UK20-104	C.D., .1uf, 20V	71596	6-24104
C28	UK20-104	C.D., .1uf, 20V	71596	6-24104
C29	UK20-104	C.D., .1uf, 20V	71596	6-24104
C30	K33E20	Tant., 33uf, 20V	05397	6-74336
C31	K330E6	Tant., 330uf, 6V	05397	6-71337
C32	K33E20	Tant., 33uf, 20V	05397	6-74336
C33	K1E35	Tant., 1uf, 35V	05397	6-75105
C34	5HKS10	D.C., .01uf, 100V	71590	6-28103
C35	UK20-104	C.D., .1uf, 20V	71596	6-24104
C36	UK20-104	C.D., .1uf, 20V	71596	6-24104
C37	K1E35	Tant., 1uf, 35V	05397	6-75105
C38	DM15FD151J03	D.M., 150pf, 500V, 5%	04062	6-19151
C39	K1E35	Tant., 1uf, 35V	05397	6-75105
C40	UK20-104	C.D., .1uf, 20V	71596	6-24104
C41	UK20-104	D.C., .1uf, 20V	71596	6-24104
C42	DM15FD220J03	D.M., 22pf, 500V, 5%	04062	6-19220

TABLE 6-2 (continued) ASSEMBLY A2

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
		COILS		
L1-L6	1537-76	Choke, 100uh, R.F.	DELEVAN	5-90007
		DIODES		
CR1-12	1N914	Signal 1N914	F.S.	3-10914
		TRANSISTORS		
Q 1	2N4275	NPN 2N4275	07263	3-24275
Q 2	2N4275	NPN 2N4275	07263	3-24275
Q 3	2N4275	NPN 2N4275	07263	3-24275
Q 4	2N4275	NPN 2N4275	07263	3-24275
Q 5	2N4275	NPN 2N4275	07263	3-24275
Q 6	2N4275	NPN 2N4275	07263	3-24275
Q 7	2N4275	NPN 2N4275	07263	3-24275
Q 8	2N4275	NPN 2N4275	07263	3-24275
Q 9	2N4275	NPN 2N4275	07263	3-24275
Q10	2N4275	NPN 2N4275	07263	3-24275
Q11	2N4275	NPN 2N4275	07263	3-24275
Q12	2N4275	NPN 2N4275	07263	3-24275
Q13	2N4275	NPN 2N4275	07263	3-24275
Q14	2N4275	NPN 2N4275	07263	3-24275
Q15	2N4275	NPN 2N4275	07263	3-24275
Q16	2N4275	NPN 2N4275	07263	3-24275
Q17	2N2484	NPN 2N2484	07263	3-22484
Q18	2N2484	NPN 2N2484	07263	3-22484
Q19	2N2484	NPN 2N2484	07263	3-22484
Q20	2N2484	NPN 2N2484	07263	3-22484
Q21	2N4275	NPN 2N4275	07263	3-24275
Q22	2N4275	NPN 2N4275	07263	3-24275
Q23	2N4275	NPN 2N4275	07263	3-24275
Q24	2N4126	PNP 2N4126	04713	3-24126
Q25	2N4126	PNP 2N4126	04713	3-24126
Q26	2N4126	PNP 2N4126	04713	3-24126
Q27	2N4126	PNP 2N4126	04713	3-24126
Q28	2N4275	NPN 2N4275	07263	3-24275
		INTEGRATED CIRCUITS		
U1	SN7400N	Gate SN7400	01294	3-37400
U2	SN74196N	Counter SN74196	01294	3-34196
U3	LM318H	AMP LM318	NAT'L	3-30318
U4	LM301A	AMP LM301A	NAT'L	3-30301
		RESISTORS		
R 1	RC07GF182J	C.C. 1.8Kohm 1/4W 5%	01121	5-10182
R 2	RC07GF471J	C.C. 470ohm 1/4W 5%	01121	5-10471
R 3	RC07GF471J	C.C. 470ohm 1/4W 5%	01121	5-10471
R 4	RC07GF821J	C.C. 820ohm 1/4W 5%	01121	5-10821
R 5	RC07GF821J	C.C. 820ohm 1/4W 5%	01121	5-10821
R 6	RC07GF821J	C.C. 820ohm 1/4W 5%	01121	5-10821

TABLE 6-2 (continued) ASSEMBLY A2

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
R 7	RC07GF471J	C.C. 470ohm 1/4W 5%	01121	5-10471
R 8	RC07GF471J	C.C. 470ohm 1/4W 5%	01121	5-10471
R 9	RC07GF123J	C.C. 12K 1/4W 5%	01121	5-10123
R10	RC07GF821J	C.C. 820ohm 1/4W 5%	01121	5-10821
R11	RC07GF271J	C.C. 270ohm 1/4W 5%	01121	5-10271
R12	RC07GF102J	C.C. 1Kohm 1/4W 5%	01121	5-10102
R13	RC07GF4R7	C.C. 4.7ohm 1/4W 5%	01121	5-104R7
R14	RC07GF101J	C.C. 100ohm 1/4W 5%	01121	5-10101
R15	RC07GF391J	C.C. 390ohm 1/4W 5%	01121	5-10391
R16	RC07GF151J	C.C. 150ohm 1/4W 5%	01121	5-10151
R17	RC07GF391J	C.C. 390ohm 1/4W 5%	01121	5-10391
R18	RC07GF391J	C.C. 390ohm 1/4W 5%	01121	5-10391
R19	RC07GF391J	C.C. 390ohm 1/4W 5%	01121	5-10391
R20	RC07GF391J	C.C. 390ohm 1/4W 5%	01121	5-10391
R21	RC07GF391J	C.C. 390ohm 1/4W 5%	01121	5-10391
R22	RC07GF391J	C.C. 390ohm 1/4W 5%	01121	5-10391
R23	RC07GF391J	C.C. 390ohm 1/4W 5%	01121	5-10391
R24	RC07GF151J	C.C. 150ohm 1/4W 5%	01121	5-10151
R25	RC07GF151J	C.C. 150ohm 1/4W 5%	01121	5-10151
R26	RC07GF471J	C.C. 470ohm 1/4W 5%	01121	5-10471
R27	RC07GF221J	C.C. 220ohm 1/4W 5%	01121	5-10221
R28	RC07GF183J	C.C. 18Kohm 1/4W 5%	01121	5-10183
R29	RC07GF220J	C.C. 22ohm 1/4W 5%	01121	5-10220
R30	RC07GF152J	C.C. 1.5Kohm 1/4W 5%	01121	5-10152
R31	RC07GF473J	C.C. 47Kohm 1/4W 5%	01121	5-10473
R32	RC07GF473J	C.C. 47Kohm 1/4W 5%	01121	5-10473
R33	RC07GF473J	C.C. 47Kohm 1/4W 5%	01121	5-10473
R34	RC07GF473J	C.C. 47Kohm 1/4W 5%	01121	5-10473
R35	RC07GF470J	C.C. 47ohm 1/4W 5%	01121	5-10470
R36	RC07GF272J	C.C. 2.7Kohm 1/4W 5%	01121	5-10272
R37	RC07GF272J	C.C. 2.7Kohm 1/4W 5%	01121	5-10272
R38	RC07GF272J	C.C. 2.7Kohm 1/4W 5%	01121	5-10272
R39	RC07GF272J	C.C. 2.7Kohm 1/4W 5%	01121	5-10272
R40	RC07GF470J	C.C. 47ohm 1/4W 5%	01121	5-10470
R41	RC07GF272J	C.C. 2.7Kohm 1/4W 5%	01121	5-10272
R42	RC07GF272J	C.C. 2.7Kohm 1/4W 5%	01121	5-10272
R43	RC07GF272J	C.C. 2.7Kohm 1/4W 5%	01121	5-10272
R44	RC07GF272J	C.C. 2.7Kohm 1/4W 5%	01121	5-10272
R45	RC07GF392J	C.C. 3.9Kohm 1/4W 5%	01121	5-10392
R46	RC07GF392J	C.C. 3.9Kohm 1/4W 5%	01121	5-10392
R47	RC07GF392J	C.C. 3.9Kohm 1/4W 5%	01121	5-10392
R48	RC07GF392J	C.C. 3.9Kohm 1/4W 5%	01121	5-10392
R49	RC07GF4R7J	C.C. 4.7ohm 1/4W 5%	01121	5-104R7
R50	RC07GF183J	C.C. 18Kohm 1/4W 5%	01121	5-10183
R51	RC07GF183J	C.C. 18Kohm 1/4W 5%	01121	5-10183

TABLE 6-2 (continued) ASSEMBLY A2

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
R52	RC07GF183J	C.C. 18Kohm 1/4W 5%	01121	5-10183
R53	RC07GF183J	C.C. 18Kohm 1/4W 5%	01121	5-10183
R54	RC07GF100J	C.C. 10ohm 1/4W 5%	01121	5-10100
R55	RN55D2211F	M.F. 2.21Kohm 1/8W 1%	91637	5-51226
R56	RC07GF562J	C.C. 5.6Kohm 1/4W 5%	01121	5-10562
R57	RC07GF122J	C.C. 1.2Kohm 1/4W 5%	01121	5-10122
R58	RC07GF333J	C.C. 33Kohm 1/4W 5%	01121	5-10333
R59	RC07GF333J	C.C. 33Kohm 1/4W 5%	01121	5-10333
R60	72XWR5K	VAR. 5Kohm	BECKMAN	5-73502
R61	RC07GF331J	C.C. 330ohm 1/4W 5%	01121	5-10331
R62	RC07GF331J	C.C. 330ohm 1/4W 5%	01121	5-10331
R63	RN55D3321F	M.F. 3.32Kohm 1/8W 1%	91637	5-51243
R64	RN55D3321F	M.F. 3.32Kohm 1/8W 1%	91637	5-51243
R65	RC07GF473J	C.C. 47Kohm 1/4W 5%	01121	5-10473
R66	RC07GF473J	C.C. 47Kohm 1/4W 5%	01121	5-10473
R67	RC07GF331J	C.C. 330ohm 1/4W 5%	01121	5-10331
R68	RC07GF331J	C.C. 330ohm 1/4W 5%	01121	5-10331
R69	RC07GF562J	C.C. 5.6Kohm 1/4W 5%	01121	5-10562
R70	72XWR10K	VAR. 10Kohm	BECKMAN	5-73103
R71	RC07GF104J	C.C. 100Kohm 1/4W 5%	01121	5-10104
R72	RC07GF394J	C.C. 390Kohm 1/4W 5%	01121	5-10394
R73	RC07GF561J	C.C. 560ohm 1/4W 5%	01121	5-10561
		MISCELLANEOUS		
	101501	Photocell Sub-Assy	34160	Ass'y 1015017
	2970-01-93	Terminal	CAMBION	2-23998

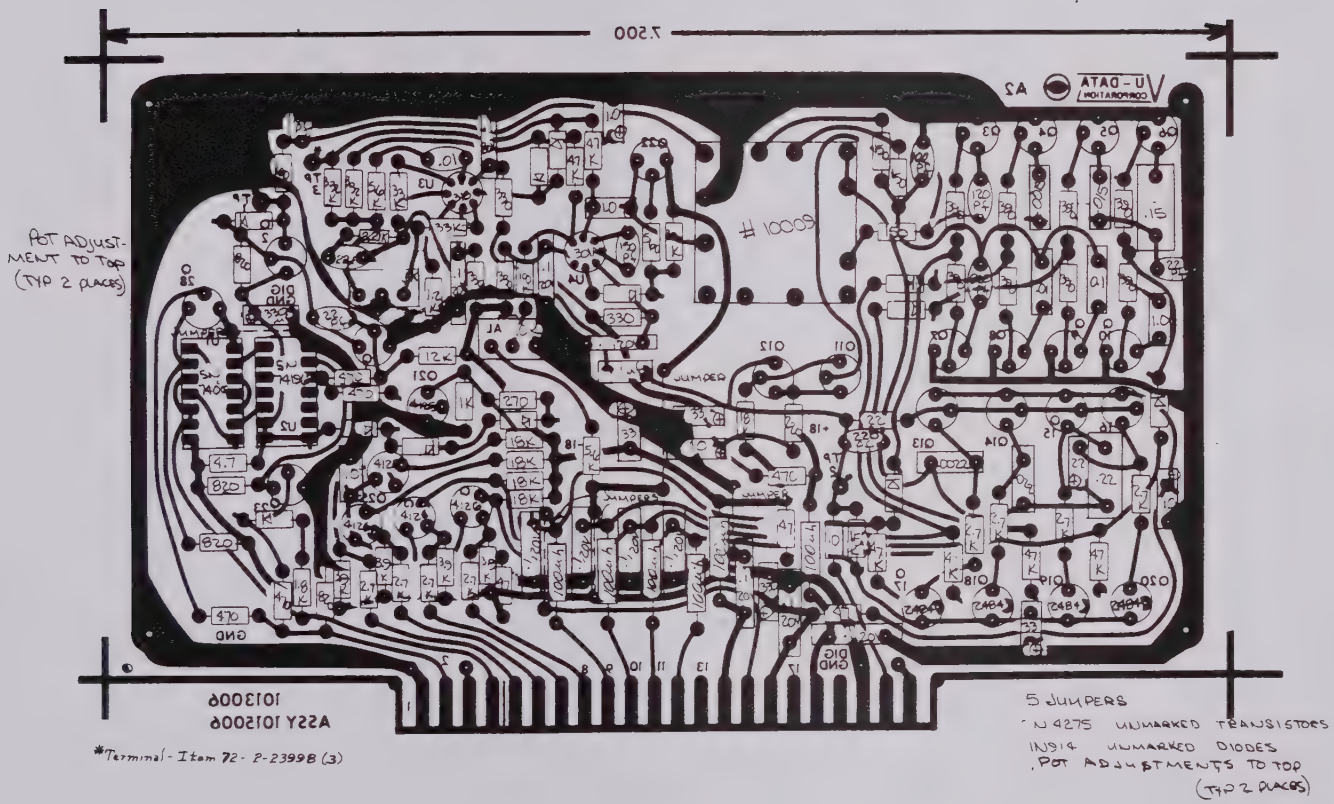
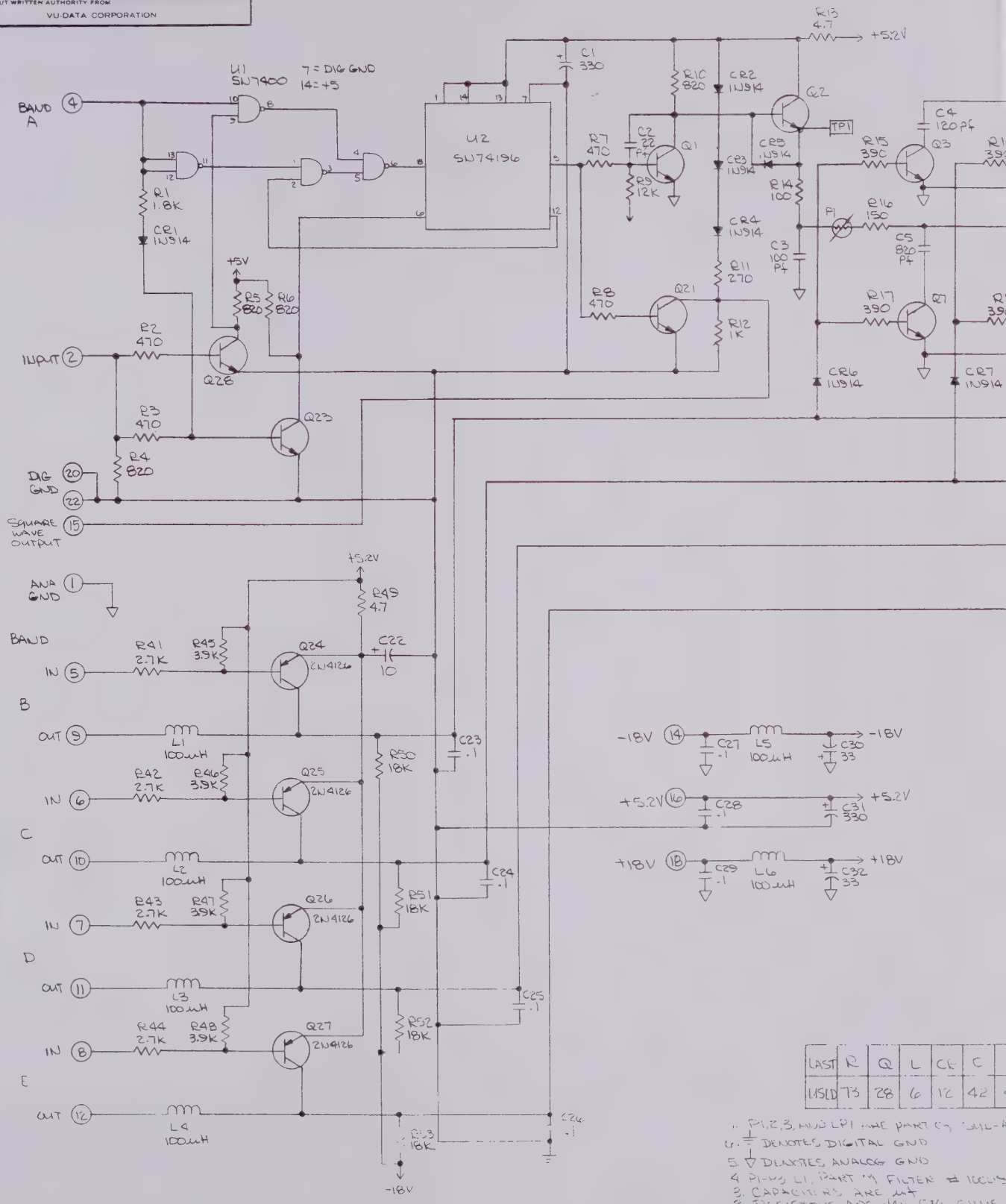

POT ADJUSTMENT TO TOP (TYP 2 PLACES)
5 JUMPERS
IN4275 UNMARKED TRANSISTORS
IN914 UNMARKED DIODES
POT ADJUSTMENTS TO TOP (TYP 2 PLACES)
*Terminal - Item 72 - 2-2399B (3)

Fig. 6-3 Assembly A-2 Parts Location

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION WHICH MAY NOT BE DISCLOSED TO OTHERS, REPRODUCED OR USED WITHOUT WRITTEN AUTHORITY FROM
VU-DATA CORPORATION



LAST	R	Q	L	CE	C
USED	73	28	6	12	42

NOTES: UNLESS OTHERWISE SPECIFIED
1. P1,2,3, AND LP1 ARE PART OF "VIL-
2. ⏚ DENOTES DIGITAL GND
3. ▽ DENOTES ANALOG GND
4. P1-3, L1, PART OF FILTER #
5. CAPACITORS ARE MF
6. RESISTORS ARE 1/4W 5%, OHMS
7. TRANSISTORS ARE 2N4275

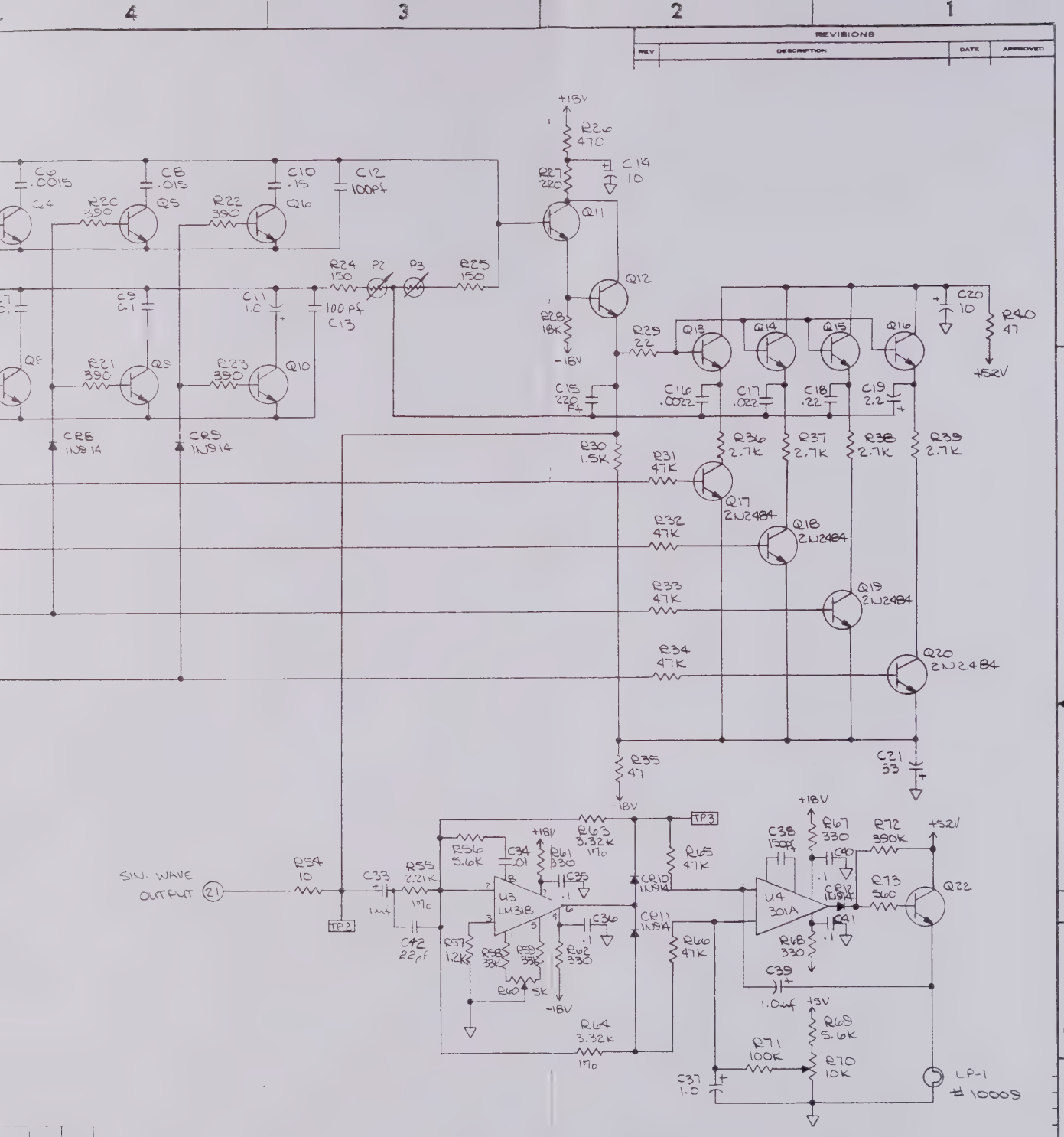

REVISIONS
REV
DESCRIPTION
DATE
APPROVED
+18V
R26 47C
R27 220
C14 10
Q11
Q12
C6 .0015
C8 .015
C10 .15
C12 100pf
R20 390
Q5
R22 390
Q6
R24 150
P2
P3
R25 150
C9 .1
C11 1.0
100 pf C13
R21 390
Q9
R23 390
Q10
R28 18K
-18V
R29 22
Q13
Q14
Q15
Q16
C20 10
R40 47
+52V
C15 220
C16 .0022
C17 .022
C18 .22
C19 2.2
CR6 1N914
CR9 1N914
R30 1.5K
R31 47K
R36 2.7K
R37 2.7K
R38 2.7K
R39 2.7K
Q17 2N2484
R32 47K
Q18 2N2484
R33 47K
Q19 2N2484
R34 47K
Q20 2N2484
R35 47
C21 33
SIN. WAVE OUTPUT
21
R54 10
C33 1mf
R55 2.21K 1%
TP2
C42 22pf
R56 5.6K
C34 .01
+18V
R61 330
C35 .1
R63 3.32K 1%
TP3
R65 47K
CR10 1N914
CR11 1N914
U3 LM318
C36 .1
R57 1.2K
R58 33K
R59 33K
R62 330
R60 5K
-18V
R64 3.32K 1%
R66 47K
C38 150pf
R67 330
C40 .1
R72 390K
+52V
R73 560
Q22
U4 301A
CR12 1N914
C41 .1
R68 330
C39 1.0uf
+5V
R69 5.6K
R71 100K
R70 10K
C37 1.0
LP-1 #10009
ITEM NO
QTY REQD
DESCRIPTION
SCHEM DES
VU-DATA PN
MIL OR VENDOR PN
CODE OR SPEC NO
LIST OF MATERIAL
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ± DECIMALS .X ±.050
ANGLES ± .XX ± .030
SURFACE FINISH ✓ .XXX ±.010
MATERIAL —
FINISH —
CONTRACT NO
DRAWN 5-19-72
CHECKED
ENGINEER
APPROVED
APPROVED
APPROVED
CUSTOMER APPROVAL
RELEASE NOV 1 5 19..
VU-DATA CORPORATION
SAN DIEGO, CALIFORNIA
SCHEMATIC
TEST OSCILLATOR FILTER
A2
SIZE D
CODE IDENT NO. 34160
DRAWING NO. 1011006
REV
SCALE
SHEET 1 OF
PART NO
QTY REQD
NEXT ASSEMBLY
USED ON
10150006
APPLICATION
1011006

TABLE 6-3 VCO-50MHZ CLOCK MODEL 101B A3

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
A3	1013002	Printed Circuit Board	34160	1-20040
		CAPACITORS		
C 1	UK20-104	C.D. .1uf 20V +80%-20%	71590	6-24104
C 2	5HKS-S10	C.D. .01uf 500V ±20%	71590	6-28103
C 3	T360C106M035AS	Tant. 10uf 35V ±20%	05397	6-75106
C 4	UK20-104	C.D. .1uf 20V +80%-20%	71590	6-24104
C 5	DM15-102J	D.M. .001uf 500V ±5%	04062	6-19102
C 6	UK20-104	C.D. .1uf 20V +80%-20%	71590	6-24104
C 7	DM15-121J	C.D. 120pf 500V ±5%	04062	6-19121
C 8	XP2A224J	Mylar .22uf 50V ±5%	IMB	6-46224
C 9	XP2A472J	Mylar .0047uf 50V ±5%	IMB	6-46472
C10	XP2A472J	Mylar .0047uf 50V ±5%	IMB	6-46472
C11	T360C106M035AS	Tant. 10uf 35V ±20%	05397	6-75106
C12	UK20-104	C.D. .1uf 20V +80%-20%	71590	6-24104
C13	T360A105K035AS	Tant. 1.0uf 35V ±10%	05397	6-75105
C14	UK20-104	C.D. .1uf 20V +80%-20%	71590	6-24104
C15	UK20-104	C.D. .1uf 20V +80%-20%	71590	6-24104
C16	T360D337M006AS	Tant. 330uf 6V ±20%	05397	6-71337
C17	UK20-104	C.D. .1uf 20V +80%-20%	71590	6-24104
C18	T360C336M020AS	Tant. 33uf 20V ±20%	05397	6-74336
C19	T360C336M020AS	Tant. 33uf 20V ±20%	05397	6-74336
C20	UK20-104	C.D. .1uf 20V +80%-20%	71590	6-24104
C21	DM15-102J	D.M. .001uf 500V ±5%	04062	6-19102
C22	UK20-104	C.D. .1uf 20V +80%-20%	71590	6-24104
C23	UK20-104	C.D. .1uf 20V +80%-20%	71590	6-24104
C24	T360D337M006AS	Tant. 330uf 6V ±20%	05397	6-71337
C25	UK20-104	C.D. .1uf 20V +80%-20%	71590	6-24104
C26	UK20-104	C.D. .1uf 20V +80%-20%	71590	6-24104
C27	UK20-104	C.D. .1uf 20V +80%-20%	71590	6-24104
C28	UK20-104	C.D. .1uf 20V +80%-20%	71590	6-24104
C29	T360A105K035AS	Tant. 1.0uf 35V ±10%	05397	6-75105
C30	UK20-104	C.D. .1uf 20V +80%-20%	71590	6-24104
C31	5HKS-S10	C.D. .01uf 500V ±20%	71590	6-28103
C32	DM15-050D	D.M. 5pf 500V ±pf	04062	6-19050
C33	UK20-104	C.D. .1uf 20V +80%-20%	71590	6-24104
		CHOKES		
L 1	1537-76	100uh	DELEVAN	5-90007
L 2	1537-76	100uh	DELEVAN	5-90007
		DIODES		
CR 1	IN914	IN914	JEDEC	3-10914
CR 2	IN752A	IN752A	JEDEC	3-10752
CR 3	IN914	IN914	JEDEC	3-10914
CR 4	MV1642	MV1642	04713	3-11642
CR 5	IN914	IN914	JEDEC	3-10914
CR 6	IN914	IN914	JEDEC	3-10914
CR 7	IN914	IN914	JEDEC	3-10914

TABLE 6-3 (continued) A3

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
CR 8	IN914	IN914	JEDEC	3-10914
CR 9	IN914	IN914	JEDEC	3-10914
CR10	IN914	IN914	JEDEC	3-10914
CR11	IN914	IN914	JEDEC	3-10914
CR12	IN914	IN914	JEDEC	3-10914
		TRANSISTORS		
Q 1	2N2484	NPN 2N2484	07263	3-22484
Q 2	2N4250	PNP 2N4250	07263	3-24250
Q 3	2N4275	NPN 2N4275	07263	3-24275
Q 4	2N4275	NPN 2N4275	07263	3-24275
Q 5	2N4275	NPN 2N4275	07263	3-24275
Q 6	2N4275	NPN 2N4275	07263	3-24275
Q 7	2N4275	NPN 2N4275	07263	3-24275
Q 8	2N4258	PNP 2N4258	07263	3-24258
Q 9	2N4275	NPN 2N4275	07263	3-24275
Q10	2N4275	NPN 2N4275	07263	3-24275
Q11	2N4258	PNP 2N4258	07263	3-24258
Q12	2N4258	PNP 2N4258	07263	3-24258
Q13	2N4275	NPN 2N4275	07263	3-24275
Q14	2N4275	NPN 2N4275	07263	3-24275
Q15	2N4275	NPN 2N4275	07263	3-24275
Q16	P1086	FET P1086	TELEDYNE	3-21086
Q17	2N2484	NPN 2N2484	07263	3-22484
Q18	2N4275	NPN 2N4275	07263	3-24275
Q19	2N4258	PNP 2N4258	07263	3-24258
Q20	2N4275	NPN 2N4275	07263	3-24275
Q21	2N4275	NPN 2N4275	07263	3-24275
Q22	2N4275	NPN 2N4275	07263	3-24275
Q23	2N4258	PNP 2N4258	07263	3-24258
Q24	2N4258	PNP 2N4258	07263	3-24258
		INTEGRATED CIRCUITS		
U 1	SN74196N	Counter SN74196	02194	3-34196
U 2	SN7490N	SN7490	01294	3-37490
U 3	SN7403N	Gate SN7403	01294	3-37403
U 4	SN7490N	SN7490	01294	3-37490
U 5	MC1013P	Counter 1013P	04713	3-31013
U 6	MC1013P	Counter 1013P	04713	3-31013
U 7	MC1013P	Counter 1013P	04713	3-31013
U 8	SN74197N	Counter SN74197	01294	3-34197
U 9	SN7400N	Gate SN7400	01294	3-37400
U10	SN7473N	FF SN7473	02194	3-37473
U11	LM301A	Amp. LM301A	NAT'L	3-30301
		RESISTORS		
R 1	RN55D1002F	M.F. 10Kohm 1/8W 1%	91637	5-51299
R 2	RN55D1501F	M.F. 1.5Kohm 1/8W 1%	91637	5-51210
R 3	RC07GF183J	C.C. 18Kohm 1/4W 5%	01121	5-10183

TABLE 6-3 (continued) A3

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
R 4	RC07GF104J	C.C. 100Kohm 1/4W 5%	01121	5-10104
R 5	RC07GF122J	C.C. 1.2Kohm 1/4W 5%	01121	5-10122
R 6	RC07GF123J	C.C. 12Kohm 1/4W 5%	01121	5-10123
R 7	RC07GF822J	C.C. 8.2Kohm 1/4W 5%	01121	5-10822
R 8	72XWR100	Var. 100ohm Cer.	BECKMAN	5-73101
R 9	RC07GF101J	C.C. 100ohm 1/4W 5%	01121	5-10101
R10	RN55D1821F	M.F. 1.82Kohm 1/8W 1%	91637	5-51218
R11	RC07GF561J	C.C. 560ohm 1/4W 5%	01121	5-10561
R12	RC07GF102J	C.C. 1Kohm 1/4W 5%	01121	5-10102
R13	72XWR500	Var. 500ohm Cer.	BECKMAN	5-73501
R14	RC07GF680J	C.C. 68ohm 1/4W 5%	01121	5-10680
R15	RC07GF182J	C.C. 1.8Kohm 1/4W 5%	01121	5-10182
R16	RC07GF101J	C.C. 100ohm 1/4W 5%	01121	5-10101
R17	RC07GF822J	C.C. 8.2Kohm 1/4W 5%	01121	5-10822
R18	RC07GF331J	C.C. 330ohm 1/4W 5%	01121	5-10331
R19	RC07GF393J	C.C. 39K 1/4W 5%	01121	5-10393
R20	RN55D9091F	M.F. 9.09Kohm 1/8W 1%	91637	5-51295
R21	RN55D2372F	M.F. 23.7Kohm 1/8W 1%	91637	5-51335
R22	RC07GF274J	C.C. 270Kohm 1/4W 5%	01121	5-10274
R23	RC07GF392J	C.C. 3.9Kohm 1/4W 5%	01121	5-10392
R24	RC07GF102J	C.C. 1Kohm 1/4W 5%	01121	5-10102
R25	RC07GF183J	C.C. 18Kohm 1/4W 5%	01121	5-10183
R26	RC07GF184J	C.C. 180Kohm 1/4W 5%	01121	5-10184
R27	RN55D2492F	M.F. 24.9K 1/8W 1%	91637	5-51337
R28	72XWR10K	Var. 10K Cer.	BECKMAN	5-73103
R29	RN55D1001F	M.F. 1.0Kohm 1/8W 1%	91637	5-51193
R30	RN55D2492F	M.F. 24.9Kohm 1/8W 1%	91637	5-51337
R31	RN55D5621F	M.F. 5.62Kohm 1/8W 1%	91637	5-51275
R32	RC07GF101J	C.C. 100ohm 1/4W 5%	01121	5-10101
R33	RC07GF104J	C.C. 100Kohm 1/4W 5%	01121	5-10104
R34	RC07GF101J	C.C. 100ohm 1/4W 5%	01121	5-10101
R35	RC07GF103J	C.C. 10Kohm 1/4W 5%	01121	5-10103
R36	RC07GF333J	C.C. 33Kohm 1/4W 5%	01121	5-10333
R37	RN55D1821F	M.F. 1.82Kohm 1/8W 1%	91637	5-51218
R38	72XWR500	Var. 500ohm Cer.	BECKMAN	5-73501
R39	RC07GF472J	C.C. 4.7Kohm 1/4W 5%	01121	5-10472
R40	RC07GF472J	C.C. 4.7Kohm 1/4W 5%	01121	5-10472
R41	RC07GF471J	C.C. 470ohm 1/4W 5%	01121	5-10471
R42	RC07GF471J	C.C. 470ohm 1/4W 5%	01121	5-10471
R43	RC07GF473J	C.C. 47Kohm 1/4W 5%	01121	5-10473
R44	RC07GF154J	C.C. 150Kohm 1/4W 5%	01121	5-10154
R45	RC07GF182J	C.C. 1.8Kohm 1/4W 5%	01121	5-10182
R46	RC07GF470J	C.C. 47ohm 1/4W 5%	01121	5-10470
R47	RC07GF220J	C.C. 22ohm 1/4W 5%	01121	5-10220
R48	RC07GF391J	C.C. 390ohm 1/4W 5%	01121	5-10391
R49	RC07GF682J	C.C. 6.8Kohm 1/4W 5%	01121	5-10682

TABLE 6-3 (continued) A3

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
R50	RC07GF100J	C.C. 10ohm 1/4W 5%	01121	5-10100
R51	RC07GF272J	C.C. 2.7K 1/4W 5%	01121	5-10272
R52	RC07GF152J	C.C. 1.5Kohm 1/4W 5%	01121	5-10152
R53	RC07GF100J	C.C. 10ohm 1/4W 5%	01121	5-10100
R54	RC07GF182J	C.C. 1.8Kohm 1/4W 5%	01121	5-10182
R55	RC07GF121J	C.C. 120ohm 1/4W 5%	01121	5-10121
R56	RC07GF471J	C.C. 470ohm 1/4W 5%	01121	5-10471
R57	RC07GF271J	C.C. 270ohm 1/4W 5%	01121	5-10271
R58	RC07GF561J	C.C. 560ohm 1/4W 5%	01121	5-10561
R59	RC07GF681J	C.C. 680ohm 1/4W 5%	01121	5-10681
R60	RC07GF681J	C.C. 680ohm 1/4W 5%	01121	5-10681
R61	RC07GF681J	C.C. 680ohm 1/4W 5%	01121	5-10681
R62	RC07GF221J	C.C. 220ohm 1/4W 5%	01121	5-10221
R63	RC07GF681J	C.C. 680ohm 1/4W 5%	01121	5-10681
R64	RC07GF101J	C.C. 100ohm 1/4W 5%	01121	5-10101
R65	RC07GF222J	C.C. 2.2Kohm 1/4W 5%	01121	5-10222
R66	RC07GF103J	C.C. 10Kohm 1/4W 5%	01121	5-10103
R67	RC07GF392J	C.C. 3.9Kohm 1/4W 5%	01121	5-10392
R68	72XWR2K	Var. 2K Cer.	BECKMAN	5-73202
		MISCELLANEOUS		
TP 1	2970-01-93	Terminal	CAMBION	2-23998
TP 2	2970-01-93	Terminal	CAMBION	2-23998
TP 3	2970-01-93	Terminal	CAMBION	2-23998
TP 4	2970-01-93	Terminal	CAMBION	2-23998
TP 5	2970-01-93	Terminal	CAMBION	2-23998
TP 6	2970-01-93	Terminal	CAMBION	2-23998
S 1	E2-104	Switch, Slide, SPDT	GC ELEC	2-10011

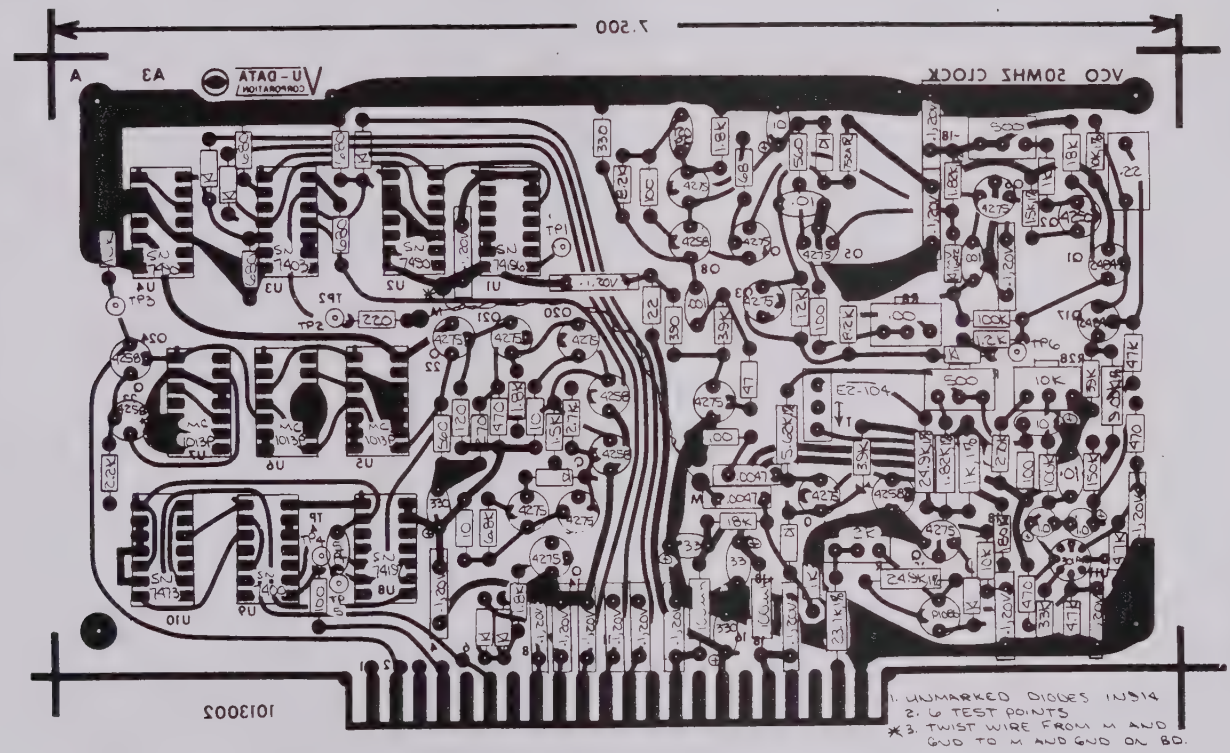
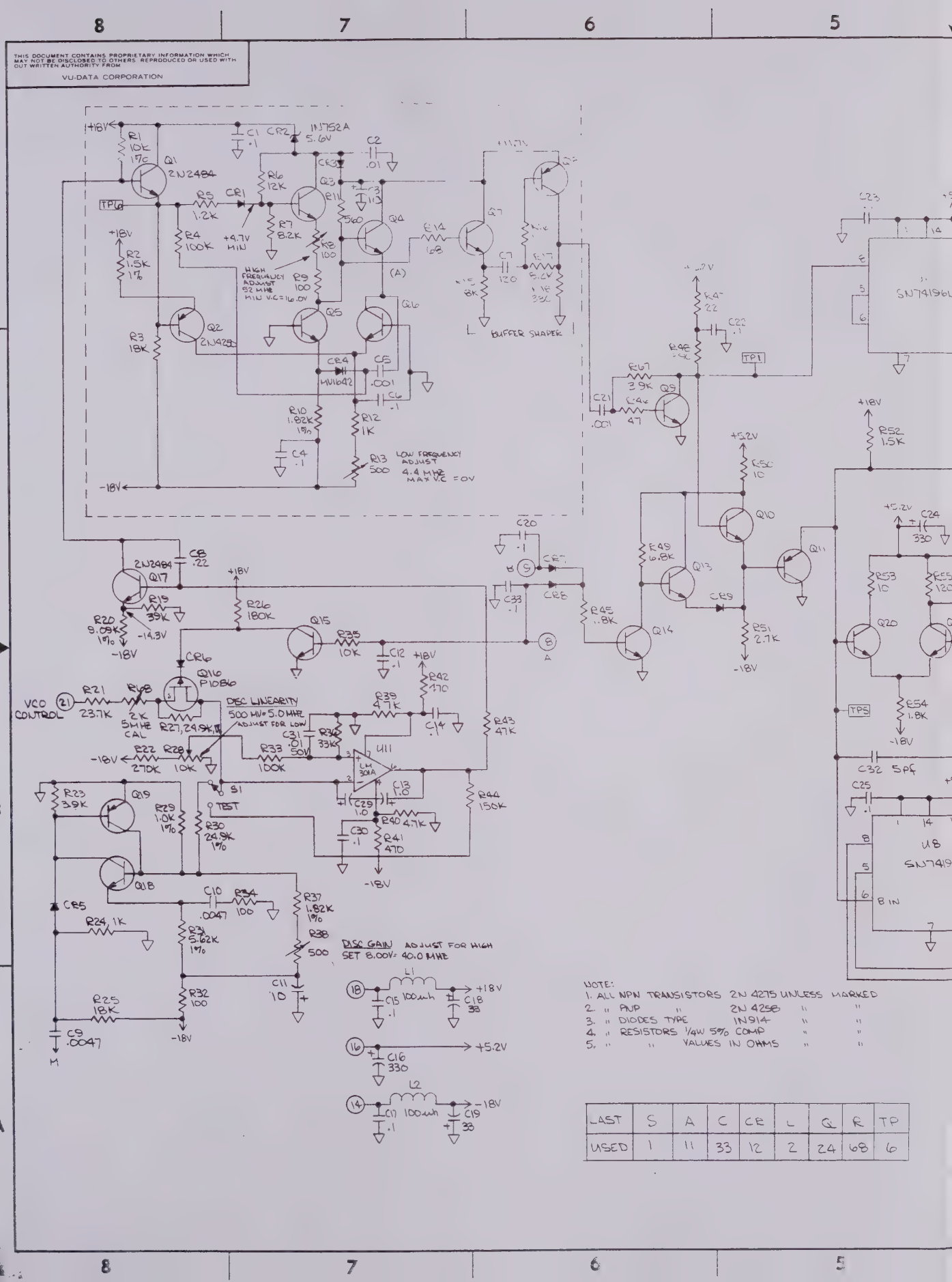

A3
U-DATA CORPORATION
VCO 50MHZ CLOCK
7.500
1. UNMARKED DIODES IN914
2. 6 TEST POINTS
3. TWIST WIRE FROM M AND GND TO M AND GND ON BD.

Fig. 6-5 Assembly A3 Parts Location

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION WHICH MAY NOT BE DISCLOSED TO OTHERS REPRODUCED OR USED WITH OUT WRITTEN AUTHORITY FROM
VU-DATA CORPORATION



NOTE:
1. ALL NPN TRANSISTORS 2N 4275 UNLESS MARKED
2. " PNP " 2N 4258 " "
3. " DIODES TYPE IN914 " "
4. " RESISTORS 1/4W 5% COMP " "
5. " " VALUES IN OHMS " "

LAST	S	A	C	CR	L	Q	R	TP
USED	1	11	33	12	2	24	68	6

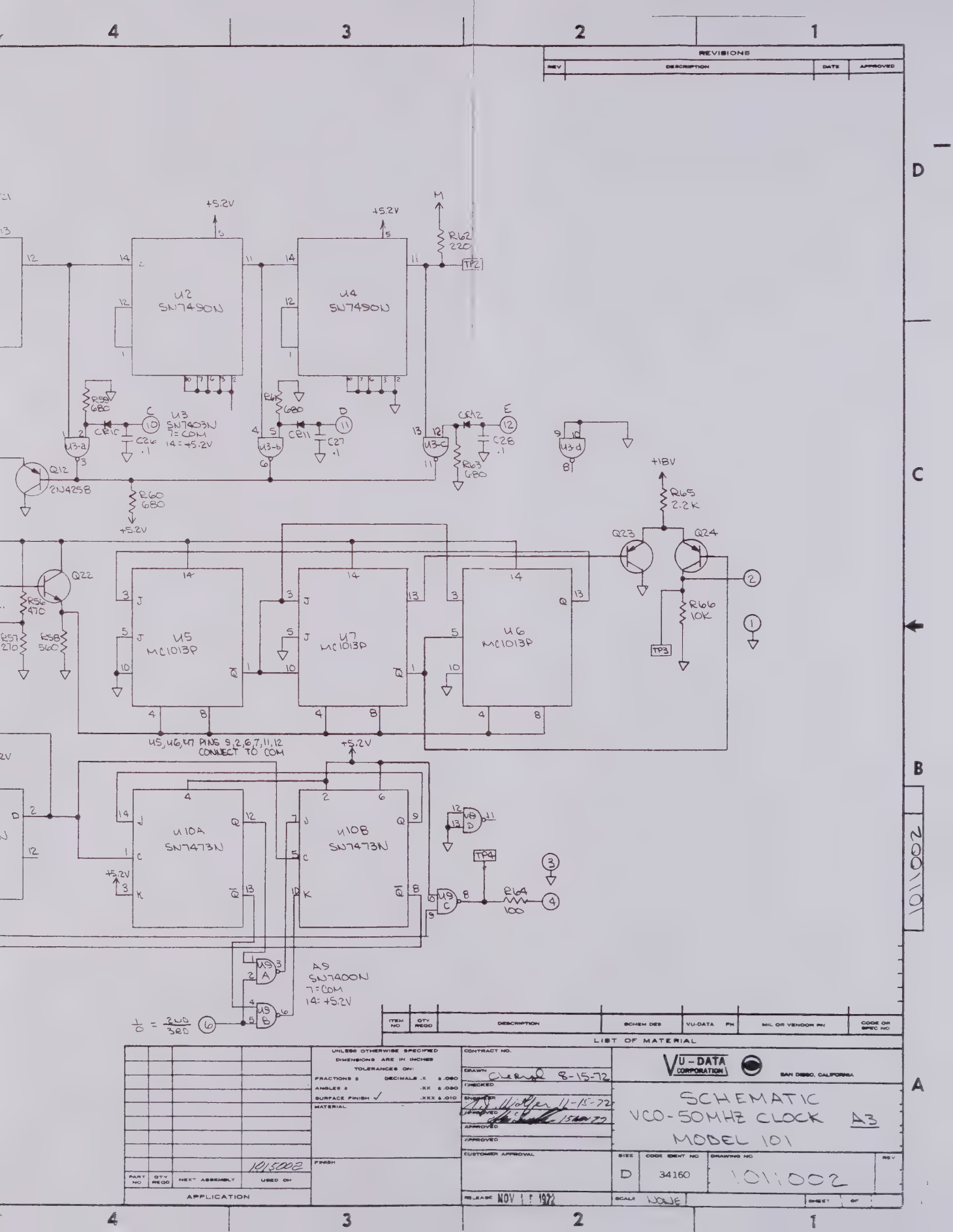

REVISIONS
REV
DESCRIPTION
DATE
APPROVED
+5.2V
U2
SN7490N
U4
SN7490N
R62
220
TP2
R59
680
R61
680
U3
SN7403N
7=COM
14=+5.2V
CR10
CR11
CR12
C26
.1
C27
.1
C28
.1
U3-a
U3-b
U3-c
U3-d
Q12
2N4258
R60
680
+18V
R65
2.2K
Q23
Q24
Q22
R56
470
R57
270
R58
560
U5
MC1013P
U7
MC1013P
U6
MC1013P
R66
10K
TP3
U5, U6, U7 PINS 9,2,6,7,11,12
CONNECT TO COM
U10A
SN7473N
U10B
SN7473N
U9
A
B
C
D
TP4
R64
100
A5
SN7400N
7=COM
14=+5.2V
1/0 = 2N0 320
ITEM NO
QTY REQD
DESCRIPTION
SCHEM DES
VU-DATA PN
MIL OR VENDOR PN
CODE OR SPEC NO
LIST OF MATERIAL
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ±
DECIMALS .X ±.060
ANGLES ±
.XX ±.030
SURFACE FINISH ✓
.XXX ±.010
MATERIAL
FINISH
CONTRACT NO.
DRAWN
CHECKED
ENGINEER
APPROVED
APPROVED
CUSTOMER APPROVAL
RELEASE NOV 1 5 1972
8-15-72
11-15-72
VU-DATA CORPORATION
SAN DIEGO, CALIFORNIA
SCHEMATIC
VCO-50MHZ CLOCK A3
MODEL 101
SIZE
D
CODE IDENT NO
34160
DRAWING NO
101002
REV
SCALE
NONE
SHEET
OF
PART NO
QTY REQD
NEXT ASSEMBLY
USED ON
10150002
APPLICATION
101002

TABLE 6-7 AUTO RANGE SUB-ASSY 101B A7

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
A7	1013003	Printed Circuit Board	34160	1-20044
		CAPACITORS		
C 1	UK20-104	C.D. .1uf 20V	71590	6-24104
C 2	T360D337M006AS	Tant. 330uf 6V	05397	6-71337
C 3	UK20-104	C.D. .1uf 20V	71590	6-24104
C 4	T360C336M020AS	Tant. 33uf 20V	05397	6-74336
C 5	DM15-111J	D.M. 110pf 500V	04062	6-19111
C 6	DM15-102J	D.M. 1nf 500V	04062	6-19102
C 7	T360C336M020AS	Tant. 33uf 20V	05397	6-74336
C 8	T360D337M006AS	Tant. 330uf 6V	05397	6-71337
C 9	T360C106M035AS	Tant. 10uf 35V	05397	6-75106
C10	T360C106M035AS	Tant. 10uf 35V	05397	6-75106
C11	T360D107M020AS	Tant. 100uf 20V	05397	6-74107
C12	UK20-104	C.D. .1uf 20V	71590	6-24104
C13	T360D107M020AS	Tant. 100uf 20V	05397	6-74107
C14	DM15-111J	D.M. 110pf 500V	04062	6-19111
C15	DM15-102J	D.M. 1nf 500V	04062	6-19102
C16	T360D337M006AS	Tant. 330uf 6V	05397	6-71337
C17	UK20-104	C.D. .1uf 20V	71590	6-24104
C18	T360D107M020AS	Tant. 100uf 20V	05397	6-74107
C19	T360D107M020AS	Tant. 100uf 20V	05397	6-74107
C20	T360D337M006AS	Tant. 330uf 6V	05397	6-71337
C21	DDM-103	C.D. .01uf 150V	71590	6-28103
C22	UK20-104	C.D. .1uf 20V	71590	6-24104
C23	UK20-104	C.D. .1uf 20V	71590	6-24104
C24	T360C106M035AS	Tant. 10uf 35V	05397	6-75106
C25	UK20-104	C.D. .1uf 20V	71590	6-24104
C26	UK20-104	C.D. .1uf 20V	71590	6-24104
C27	DM15-151J	D.M. 150pf 500V	04062	6-19151
C28	T360C106M035AS	Tant. 10uf 35V	05397	6-75106
C29	UK20-104	C.D. .1uf 20V	71590	6-24104
C30	T360D337M006AS	Tant. 330uf 6V	05397	6-71337
C31	T360D207M010AS	Tant. 200uf 10V	05397	6-72207
C32	UK20-104	C.D. .1uf 20V	05397	6-24104
C33	DDM-103	C.D. .01uf 150V	71590	6-28103
C34	DDM-103	C.D. .01uf 150V	71590	6-28103
C35	DDM-103	C.D. .01uf 150V	71590	6-28103
C36	UK20-104	C.D. .1uf 20V	05397	6-24104
C37	UK20-104	C.D. .1uf 20V	05397	6-24104
		CHOKE		
L 1	1537-76	100uh	DELEVAN	5-90007
L 2	1537-76	100uh	DELEVAN	5-90007
		DIODES		
CR 1	IN914	Signal IN914	JEDEC	3-10914
CR 2	IN914	Signal IN914	JEDEC	3-10914

TABLE 6-7 (continued) A7

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
CR 3	IN914	Signal IN914	JEDEC	3-10914
CR 4	IN756A	Zener IN756A	04713	3-10756
CR 5	IN756A	Zener IN756A	04713	3-10756
CR 6	IN914	Signal IN914	JEDEC	3-10914
CR 7	IN914	Signal IN914	JEDEC	3-10914
CR 8	IN914	Signal IN914	JEDEC	3-10914
CR 9	IN914	Signal IN914	JEDEC	3-10914
CR10	IN914	Signal IN914	JEDEC	3-10914
CR11	IN751A	Zener IN751A	JEDEC	3-10751
CR12	IN914	Signal IN914	JEDEC	3-10914
CR13	IN914	Signal IN914	JEDEC	3-10914
CR14	IN914	Signal IN914	JEDEC	3-10914
CR15	IN270	Signal IN270	JEDEC	3-10270
CR16	IN270	Signal IN270	JEDEC	3-10270
		TRANSISTORS		
Q 1	2N3694	NPN 2N3694	07263	3-23694
Q 2	2N3694	NPN 2N3694	07263	3-23694
Q 3	2N3694	NPN 2N3694	07263	3-23694
Q 4	2N4275	NPN 2N4275	07263	3-24275
Q 5	2N4275	NPN 2N4275	07263	3-24275
Q 6	2N3694	NPN 2N3694	07263	3-23694
Q 7	2N3694	NPN 2N3694	07263	3-23694
Q 8	2N4250	PNP 2N4250	07263	3-24250
Q 9	2N4250	PNP 2N4250	07263	3-24250
Q10	2N3694	NPN 2N3694	07263	3-23694
		INTEGRATED CIRCUITS		
U 1	733	Amp. 733	NAT'L	3-30733
U 2	733	Amp. 733	NAT'L	3-30733
U 3	LM318	Amp. 318	NAT'L	3-30318
U 4	LM301A	Amp. 301A	NAT'L	3-30301
U 5	LM301A	Amp. 301A	NAT'L	3-30301
U 6	LM301A	Amp. 301A	NAT'L	3-30301
U 7	LM301A	Amp. 301A	NAT'L	3-30301
U 8	SN7473N	SN7473	02194	3-37473
U 9	SN7400N	SN7400	02194	3-37400
		RESISTORS		
R 1	RC07GF562J	C.C. 5.6Kohm 1/4W 5%	01121	5-10562
R 2	RN55D2001F	M.F. 2Kohm 1/8W 1%	91637	5-51222
R 3	RC07GF102J	C.C. 1Kohm 1/4W 5%	01121	5-10102
R 4	RC07GF183J	C.C. 18Kohm 1/4W 5%	01121	5-10183
R 5	RC07GF683J	C.C. 68Kohm 1/4W 5%	01121	5-10683
R 6	72XWR100	Var. 100ohm Cer.	BECKMAN	5-73101
R 7	RC07GF151J	C.C. 150ohm 1/4W 5%	01121	5-10151
R 8	RC07GF821J	C.C. 820ohm 1/4W 5%	01121	5-10821
R 9	RC07GF272	C.C. 2.7Kohm 1/4W 5%	01121	5-10272

TABLE 6-7 (continued) A7

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
R10	RC07GF331	C.C. 330ohm 1/4W 5%	01121	5-10331
R11	RC07GF331	C.C. 330ohm 1/4W 5%	01121	5-10331
R12	RC07GF331	C.C. 330ohm 1/4W 5%	01121	5-10331
R13	RC07GF331	C.C. 330ohm 1/4W 5%	01121	5-10331
R14	72XWR5K	Var. 5K Cer.	BECKMAN	5-73502
R15	RC07GF181J	C.C. 180ohm 1/4W 5%	01121	5-10181
R16	RC07GF181J	C.C. 180ohm 1/4W 5%	01121	5-10181
R17	RN55D5110F	M.F. 511ohm 1/8W 1%	91637	5-51164
R18	RC07GF562J	C.C. 5.6Kohm 1/4W 5%	01121	5-10562
R19	RN55D2001F	M.F. 2Kohm 1/8W 1%	91637	5-51222
R20	RC07GF183J	C.C. 18Kohm 1/4W 5%	01121	5-10183
R21	RC07GF151J	C.C. 150ohm 1/4W 5%	01121	5-10151
R22	72XWR100	Var. 100ohm Cer.	BECKMAN	5-73101
R23	RC07GF821J	C.C. 820ohm 1/4W 5%	01121	5-10821
R24	RC07GF272	C.C. 2.7Kohm 1/4W 5%	01121	5-10272
R25	RC07GF331	C.C. 330ohm 1/4W 5%	01121	5-10331
R26	RC07GF331	C.C. 330ohm 1/4W 5%	01121	5-10331
R27	RC07GF181J	C.C. 180ohm 1/4W 5%	01121	5-10181
R28	72XWR5K	Var. 5K Cer.	BECKMAN	5-73502
R29	RN55D5110F	M.F. 511ohm 1/8W 1%	91637	5-51164
R30	RC07GF181J	C.C. 180ohm 1/4W 5%	01121	5-10181
R31	RN55D2211F	M.F. 2.21Kohm 1/8W 1%	91637	5-51226
R32	RN55D2211F	M.F. 2.21Kohm 1/8W 1%	91637	5-51226
R33	RC07GF682J	C.C. 6.8Kohm 1/4W 5%	01121	5-10682
R34	RC07GF102J	C.C. 1Kohm 1/4W 5%	01121	5-10102
R35	RN55D2211F	M.F. 2.21Kohm 1/8W 1%	91637	5-51226
R36	RC07GF331	C.C. 330ohm 1/4W 5%	01121	5-10331
R37	RC07GF331	C.C. 330ohm 1/4W 5%	01121	5-10331
R38	72XWR5R	Var. 5K Cer.	BECKMAN	5-73502
R39	RC07GF333J	C.C. 33Kohm 1/4W 5%	01121	5-10333
R40	RC07GF333J	C.C. 33Kohm 1/4W 5%	01121	5-10333
R41	RN55D1002F	M.F. 10Kohm 1/8W 1%	91637	5-51299
R42	RN55D1002F	M.F. 10Kohm 1/8W 1%	91637	5-51299
R43	RN55D5362F	M.F. 53.6Kohm 1/8W 1%	91637	5-50508
R44	RC07GF331	C.C. 330ohm 1/4W 5%	01121	5-10331
R45	RC07GF331	C.C. 330ohm 1/4W 5%	01121	5-10331
R46	RN55D5362F	M.F. 53.6Kohm 1/8W 1%	91637	5-50508
R47	RC07GF101J	C.C. 100ohm 1/4W 5%	01121	5-10101
R48	RC07GF101J	C.C. 100ohm 1/4W 5%	01121	5-10101
R49	RN55D1332F	M.F. 13.3Kohm 1/8W 1%	91637	5-51311
R50	RN55D3572F	M.F. 35.7Kohm 1/8W 1%	91637	5-51352
R51	RC07GF103J	C.C. 10Kohm 1/4W 5%	01121	5-10103
R52	RC07GF562J	C.C. 5.6Kohm 1/4W 5%	01121	5-10562
R53	RC07GF153J	C.C. 15Kohm 1/4W 5%	01121	5-10153
R54	RC07GF272	C.C. 2.7Kohm 1/4W 5%	01121	5-10272

TABLE 6-7 (continued) A7

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
R55	72XWR500	Var. 500ohm Cer.	BECKMAN	5-73501
R56	RN55D2371F	M.F. 2.37Kohm 1/8W 1%	91637	5-51229
R57	RC07GF101J	C.C. 100ohm 1/4W 5%	01121	5-10101
R58	RN55D1781F	M.F. 1.78Kohm 1/8W 1%	91637	5-51217
R59	RN55D5620F	M.F. 562ohm 1/8W 1%	91637	5-51168
R60	RN55D2100F	M.F. 210ohm 1/8W 1%	91637	5-51127
R61	RC07GF103J	C.C. 10Kohm 1/4W 5%	01121	5-10103
R62	RC07GF103J	C.C. 10Kohm 1/4W 5%	01121	5-10103
R63	RC07GF103J	C.C. 10Kohm 1/4W 5%	01121	5-10103
R64	RC07GF122J	C.C. 1.2Kohm 1/4W 5%	01121	5-10122
R65	RC07GF103J	C.C. 10Kohm 1/4W 5%	01121	5-10103
R66	RC07GF472J	C.C. 4.7Kohm 1/4W 5%	01121	5-10472
R67	RC07GF103J	C.C. 10Kohm 1/4W 5%	01121	5-10103
R68	RC07GF222J	C.C. 2.2Kohm 1/4W 5%	01121	5-10222
R69	RC07GF222J	C.C. 2.2Kohm 1/4W 5%	01121	5-10222
R70	RC07GF102J	C.C. 1Kohm 1/4W 5%	01121	5-10102
R71	72XWR2K	Var. 2Kohm Cer.	BECKMAN	5-73202
R72	RC07GF102J	C.C. 1Kohm 1/4W 5%	01121	5-10102
R73	RC07GF103J	C.C. 10Kohm 1/4W 5%	01121	5-10103
R74	RC07GF103J	C.C. 10Kohm 1/4W 5%	01121	5-10103
		MISCELLANEOUS		
TP 1	2970-01-93	Terminals	CAMBION	2-23998
TP 2	2970-01-93	Terminals	CAMBION	2-23998
TP 3	2970-01-93	Terminals	CAMBION	2-23998
TP 4	2970-01-93	Terminals	CAMBION	2-23998
TP 5	2970-01-93	Terminals	CAMBION	2-23998
TP 6	2970-01-93	Terminals	CAMBION	2-23998
TP 7	2970-01-93	Terminals	CAMBION	2-23998
	1012002	Shield - Circuit Board	34160	1-10407

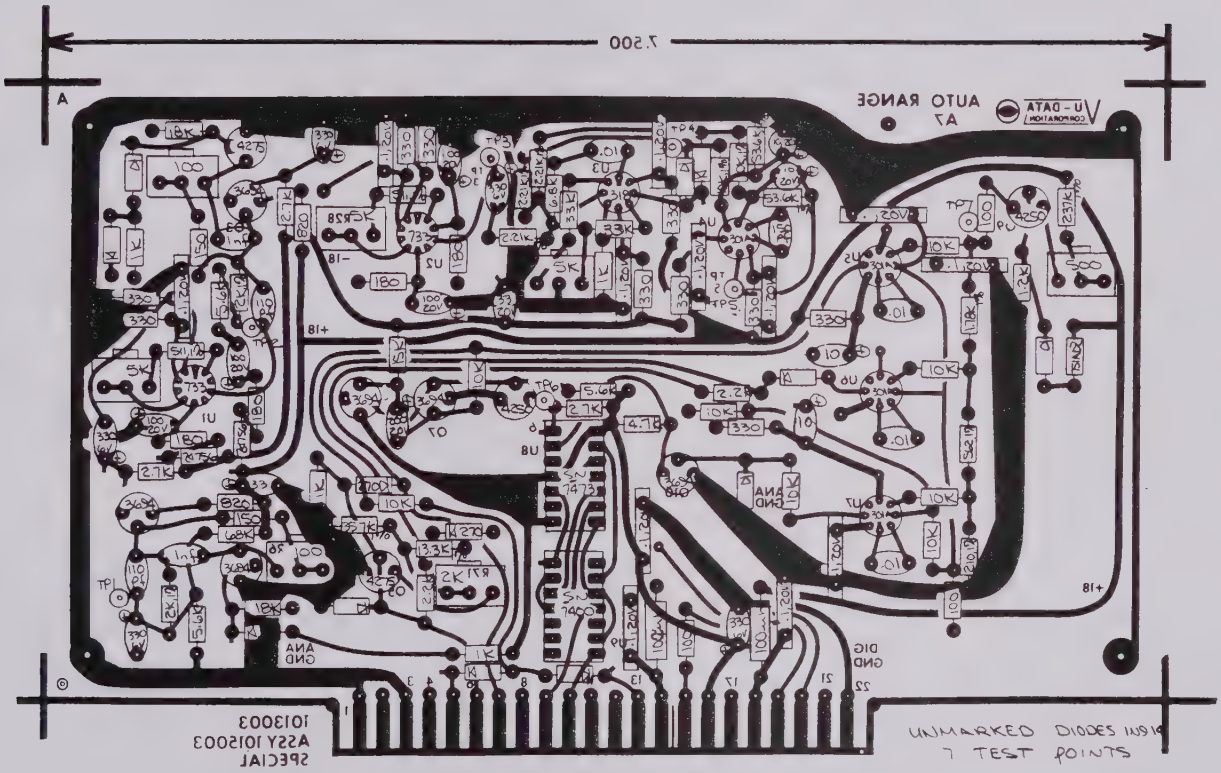
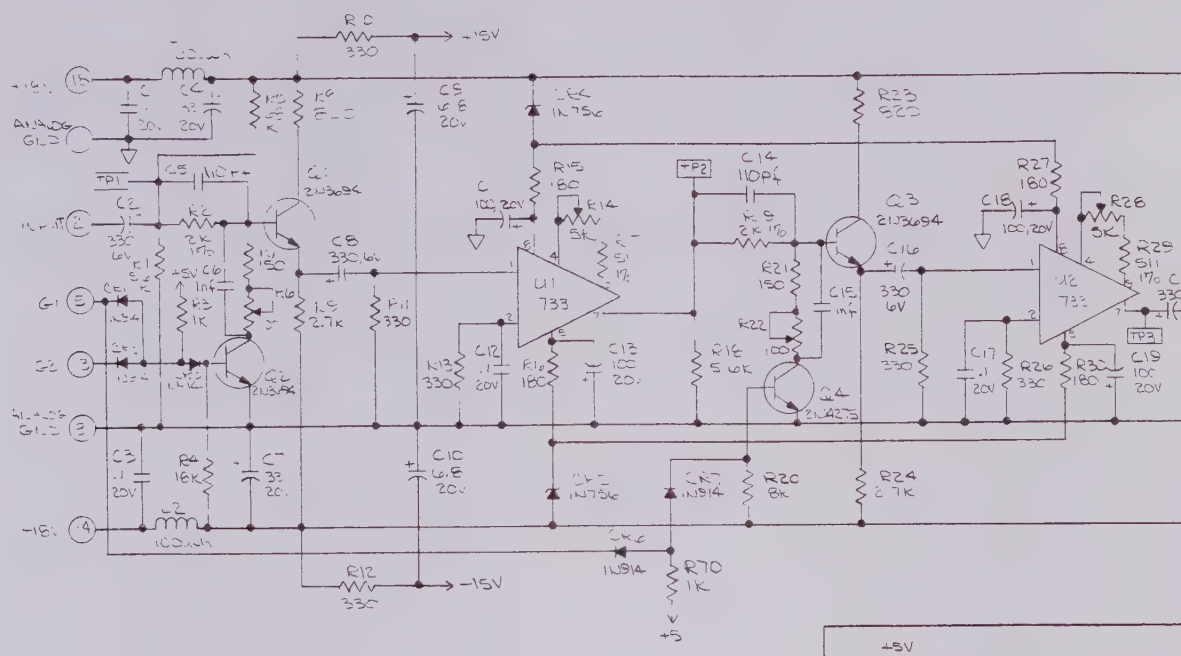
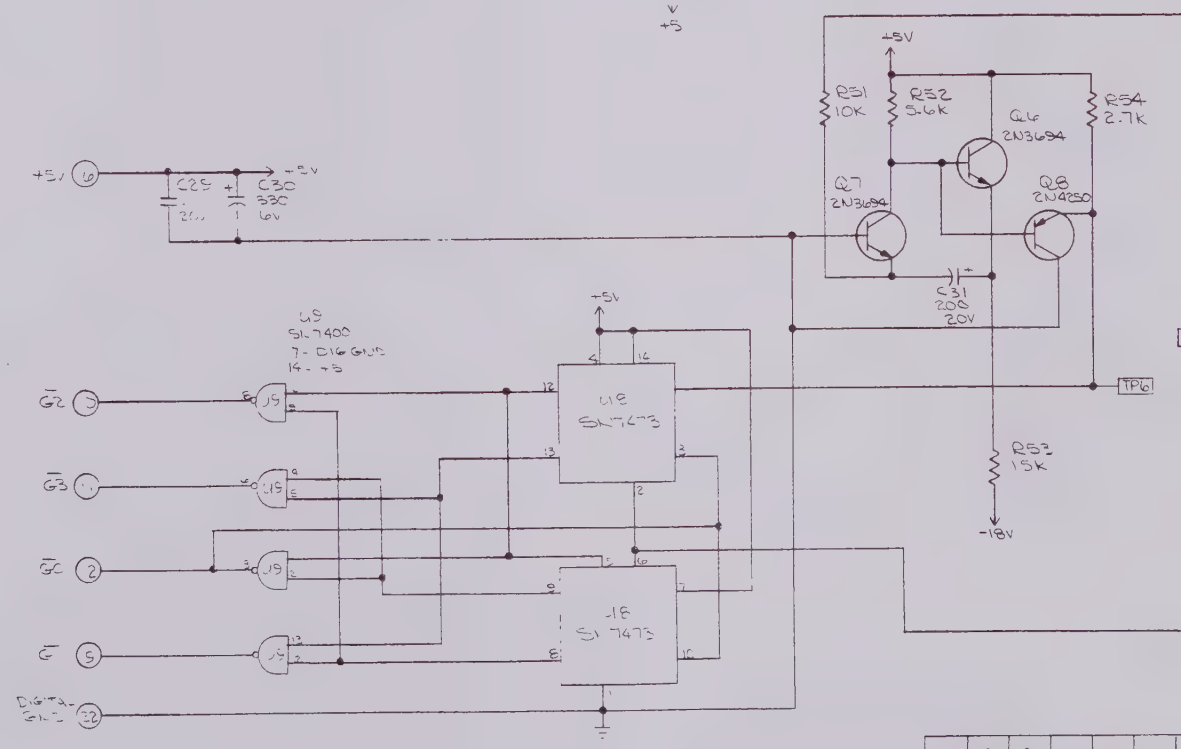


Fig. 6-13 Assembly A7 Parts Location

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION WHICH MAY NOT BE DISCLOSED TO OTHERS REPRODUCED OR USED WITH OUT WRITTEN AUTHORITY FROM
VU-DATA CORPORATION





USED	C	R	Q	CR	TP
	37	74	10	16	7

< = DENOTES ANALOG GROUND
= DENOTES DIGITAL GROUND
ALL CAPAC TORS IN mf
ALL RESISTORS 1/4W ±5% UNLESS
UNLESS OTHERWISE SPECIFIED

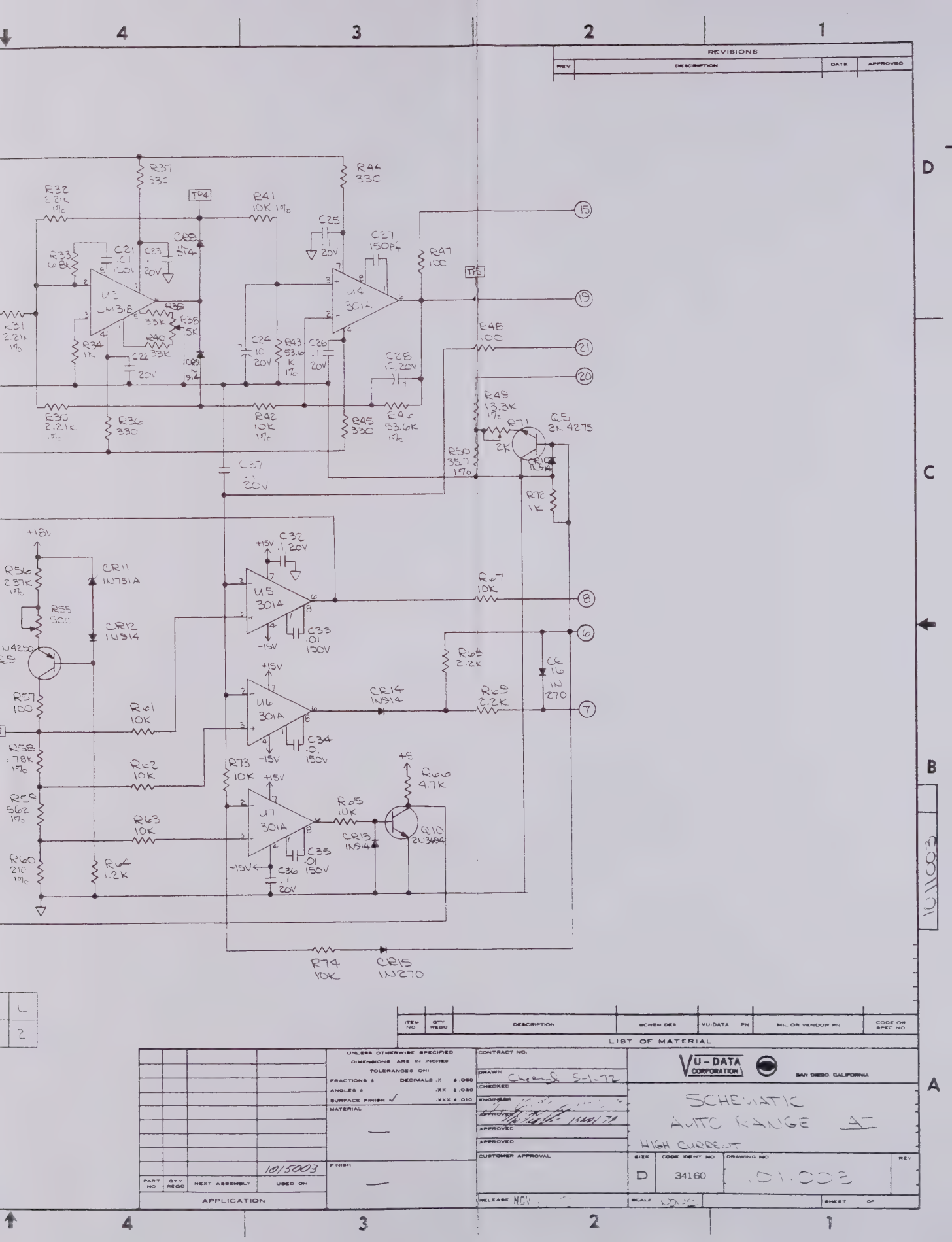

REVISIONS
REV
DESCRIPTION
DATE
APPROVED
R37 33C
R44 33C
R32 2.21K 1%
TP4
R41 10K 1%
C25 .1 20V
C27 150PF
R47 100
TP5
R33 6.8K
C21 .1 1501
C23 .1 20V
C28 1K 5%
U3 LM318
R35 33K
R38 15K
R34 1K
R40 33K
C22 20V
C29 5%
R31 2.21K 1%
C24 1C 20V
R43 53.6K 1%
C26 .1 20V
U4 301A
C28 1C 20V
R48 100
R49 13.3K 1%
R35 2.21K 1%
R36 330
R42 10K 1%
R45 330
R46 53.6K 1%
R50 357 1%
Q11 2N4275
R72 1K
C37 .1 20V
+18V
R56 2.37K 1%
CR11 IN751A
R55 500
CR12 IN914
Q12 U4250
R57 100
R58 7.87K 1%
R59 562 1%
R60 210 1%
R61 10K
R62 10K
R63 10K
R64 1.2K
C32 .1 20V
U5 301A
C33 .01 150V
R67 10K
R68 2.2K
C38 16 IN 270
U6 301A
C34 .01 150V
CR14 IN914
R69 2.2K
R73 10K
U7 301A
C35 .01 150V
C36 .1 20V
R65 10K
CR13 IN914
Q10 2N3906
R66 4.7K
R74 10K
CR15 IN270
15
19
21
20
8
6
7
4
3
2
1
ITEM NO
QTY REQD
DESCRIPTION
SCHEM DES
VU-DATA PN
MIL OR VENDOR PN
CODE OR SPEC NO
LIST OF MATERIAL
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ±
DECIMALS .X ±.050
.XX ±.030
ANGLES ±
.XXX ±.010
SURFACE FINISH ✓
MATERIAL
FINISH
CONTRACT NO.
DRAWN Cheng 5-1-72
CHECKED
ENGINEER
APPROVED
APPROVED
CUSTOMER APPROVAL
RELEASE NCV
VU-DATA CORPORATION
SAN DIEGO, CALIFORNIA
SCHEMATIC
AUTO RANGE A-
HIGH CURRENT
SIZE D
CODE IDENT NO 34160
DRAWING NO 101003
REV
SCALE NONE
SHEET OF
PART NO
QTY REQD
NEXT ASSEMBLY
USED ON
10150003
APPLICATION
D
C
B
A
4
3
2
1

TABLE 6-9 REMOTE JUMPER BOARD 101B A9

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
A9	1013013	Printed Circuit Board	34160	1-20046
		DIODES		
CR 1-8	IN914	Signal IN914	JEDEC	3-10914
		TRANSISTORS		
Q 1	2N4275	NPN 2N4275	07263	3-24275
		RESISTORS		
R 1	RC07GF562J	C.C. 5.6Kohm 1/4W 5%	01121	5-10562
R 2	RC07GF821J	C.C. 820ohm 1/4W 5%	01121	5-10821
R 3	RC07GF222J	C.C. 2.2Kohm 1/4W 5%	01121	5-10222

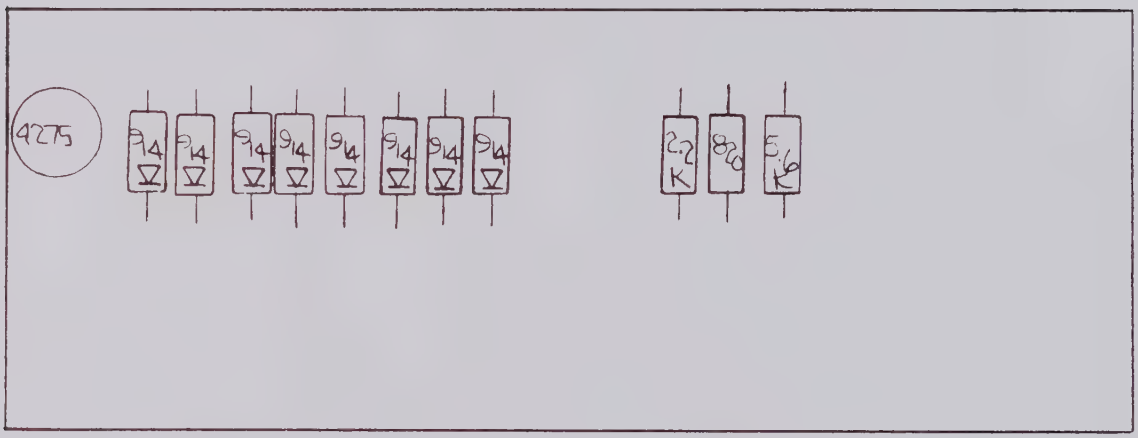
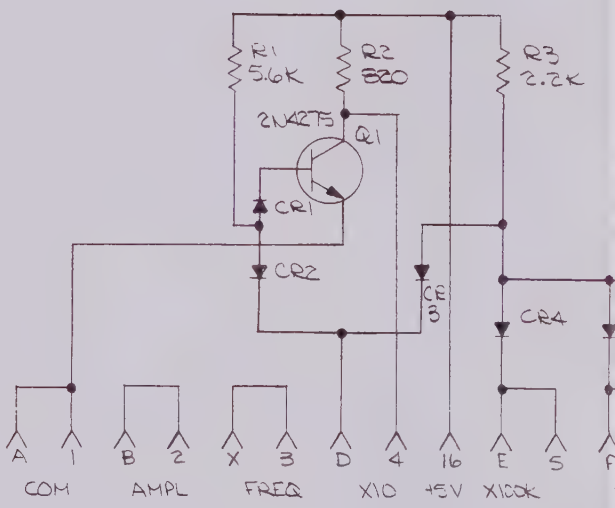


Fig. 6-17 Assembly A9 Parts Location

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION WHICH MAY NOT BE DISCLOSED TO OTHERS REPRODUCED OR USED WITH OUT WRITTEN AUTHORITY FROM

VU-DATA CORPORATION



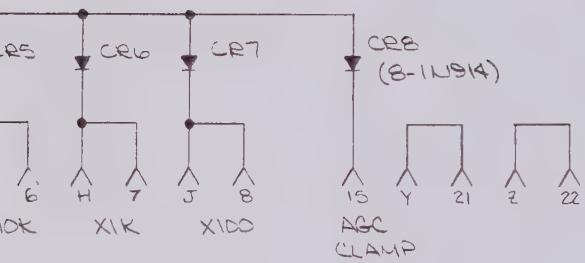
1 RESISTORS, 1/4 W, 5%, OHMS

NOTES: UNLESS OTHERWISE SPECIFIED

PART NO	QTY REQD	NEXT

APP

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



1011013

ITEM NO	QTY REQD	DESCRIPTION	SCHEM DES	VU-DATA PN	MIL OR VENDOR PN	CODE OR SPEC NO

LIST OF MATERIAL

	1011013
ASSEMBLY	USED ON
FICATION	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± DECIMALS .X ±.050
ANGLES ± .XX ±.030
SURFACE FINISH ✓ .XXX ±.010
MATERIAL —
FINISH —

CONTRACT NO.
DRAWN Cheryl 10-12-72
CHECKED
ENGINEER [illegible] 11-15-72
APPROVED [illegible] 15 NOV 72
APPROVED
APPROVED
CUSTOMER APPROVAL
RELEASE NOV 15 1972

VU-DATA CORPORATION SAN DIEGO, CALIFORNIA

SCHEMATIC
REMOTE JUMPER BD

SIZE	CODE IDENT NO	DRAWING NO	REV
C	34160	1011013	

SCALE — SHEET 1 OF 1

TABLE 6-12 POWER AMPLIFIER 101B A16

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
A16	1013001	Printed Circuit Board	34160	1-20048
		CAPACITORS		
C 1	T360C336M020AS	T.D. 33uf 20V	05397	6-74336
C 2	T360D337M006AS	T.D. 330uf 6V	05397	6-71337
C 3	T360C336M020AS	T.D. 33uf 20V	05397	6-74336
C 4	T360D337M006AS	T.D. 330uf 6V	05397	6-71337
C 5	DDM-103	C.D. .01uf 500V	71590	6-28103
C 6	UK20-104	C.D. .1uf 20V	71590	6-24104
C 7	UK20-104	C.D. .1uf 20V	71590	6-24104
C 8	DDM-103	C.D. .01uf 150V	71590	6-28103
C 9	UK20-104	C.D. .1uf 20V	71590	6-24104
C10	UK20-104	C.D. .1uf 20V	71590	6-24104
C11	T360D337M006AS	T.D. 330uf 6V	05397	6-71337
C12	T360D337M006AS	T.D. 330uf 6V	05397	6-71337
C13	DM15FD271J03	D.M. 270pf 500V	04062	6-19271
C14	T360D337M006AS	T.D. 330uf 6V	05397	6-71337
C15	T360C686M020AS	T.D. 68uf 20V	05397	6-74686
C16	T360B475M020AS	Tant. 4.7uf 20V	05397	6-74475
C17	UK20-104	C.D. .1uf 20V	71590	6-24104
C18	DM15ED330J03	D.M. 33pf 500V	04062	6-19330
C19	UK20-104	C.D. .1uf 20V	71590	6-24104
C20	T360D337M006AS	T.D. 330uf 6V	05397	6-71337
		COILS		
L 1	1537-76	RF 100uh	99800	5-90007
L 2	1537-76	RF 100uh	99800	5-90007
		DIODES		
CR 1-9	IN914	Signal IN914	JEDEC	3-10914
		TRANSISTORS		
Q 1	2N4275	NPN 2N4275	07263	3-24275
Q 2	2N4275	NPN 2N4275	07263	3-24275
Q 3	2N5682	NPN 2N5682	04713	3-25682
Q 4	2N3072	PNP 2N3072	07263	3-23072
Q 5	2N4275	NPN 2N4275	07263	3-24275
Q 6	2N4275	NPN 2N4275	07263	3-24275
Q 7	2N4275	NPN 2N4275	07263	3-24275
Q 8	2N4275	NPN 2N4275	07263	3-24275
Q 9	2N4126	PNP 2N4126	04713	3-24126
		INTEGRATED CIRCUITS		
U 1	LM318	Amp. LM318	NAT'L	3-30318
U 2	LM301A	Amp. LM301A	NAT'L	3-30301
		RESISTORS		
R 1	RC07GF472J	C.C. 4.7Kohm 1/4W 5%	01121	5-10472
R 2	RC07GF152J	C.C. 1.5Kohm 1/4W 5%	01121	5-10152
R 3	RC07GF101J	C.C. 100ohm 1/4W 5%	01121	5-10101
R 4	RC07GF222J	C.C. 2.2Kohm 1/4W 5%	01121	5-10222

TABLE 6-12 (continued) A16

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
R 5	RC07GF152J	C.C. 1.5Kohm 1/4W 5%	01121	5-10152
R 6	RC07GF101J	C.C. 100ohm 1/4W 5%	01121	5-10101
R 7	RC07GF222J	C.C. 2.2Kohm 1/4W 5%	01121	5-10222
R 8	RN55D5620F	M.F. 562ohm 1/4W 1%	91637	5-51168
R 9	RC07GF472J	C.C. 4.7Kohm 1/4W 5%	01121	5-10472
R10	RC07GF102J	C.C. 1Kohm 1/4W 5%	01121	5-10102
R11	RC07GF562J	C.C. 5.6Kohm 1/4W 5%	01121	5-10562
R12	RC07GF331J	C.C. 330ohm 1/4W 5%	01121	5-10331
R13	RC07GF331J	C.C. 330ohm 1/4W 5%	01121	5-10331
R14	RC07GF333J	C.C. 33Kohm 1/4W 5%	01121	5-10333
R15	72XWR2.5K	Var. 5Kohm Cer.	BECKMAN	5-73502
R16	RC07GF333J	C.C. 33Kohm 1/4W 5%	01121	5-10333
R17	RC07GF472J	C.C. 4.7Kohm 1/4W 5%	01121	5-10472
R18	RC07GF472J	C.C. 4.7Kohm 1/4W 5%	01121	5-10472
R19	RCRGF390J	C.C. 39ohm 1W 5%	01121	5-30390
R20	RC07GF100J	C.C. 10ohm 1/4W 5%	01121	5-10100
R21	RC07GF100J	C.C. 10ohm 1/4W 5%	01121	5-10100
R22	RCRGF390J	C.C. 39ohm 1W 5%	01121	5-30390
R23	RC07GF680J	C.C. 68ohm 1/4W 5%	01121	5-10680
R24	RN55D2210F	M.F. 221ohm 1/8W 1%	91637	5-51129
R25	RC07GF103J	C.C. 10Kohm 1/4W 5%	01121	5-10103
R26	72XWR500	Var. 500ohm Cer.	BECKMAN	5-73501
R27	RC07GF103J	C.C. 10Kohm 1/4W 5%	01121	5-10103
R28	RC07GF681J	C.C. 680ohm 1/4W 5%	01121	5-10681
R29	RC07GF392J	C.C. 3.9Kohm 1/4W 5%	01121	5-10392
R30	RC07GF561J	C.C. 560ohm 1/4W 5%	01121	5-10561
R31	RN55D2210F	M.F. 221ohm 1/8W 1%	91637	5-51129
R32	RC07GF223J	C.C. 22Kohm 1/4W 5%	01121	5-10223
R33	RN55D2741F	M.F. 2.74Kohm 1/8W 1%	91637	5-51235
R34	RC07GF223J	C.C. 22Kohm 1/4W 5%	01121	5-10223
R35	RN55D2211F	M.F. 2.21K 1/8W 1%	91637	5-51226
R36	RC07GF334J	C.C. 330Kohm 1/4W 5%	01121	5-10334
R37	RC07GF101J	C.C. 100ohm 1/4W 5%	01121	5-10101
R38	RC07GF101J	C.C. 100ohm 1/4W 5%	01121	5-10101
		MISCELLANEOUS		
J 1	51-043-0000	Conn. Coax	SEAL ECTRO	2-23995
P 1	VTL9A2/2	Photocell	VACTEC	3-50004
P 2	VTL9A2/2	Photocell	VACTEC	3-50004
P 3	VTL9A2/2	Photocell	VACTEC	3-50004
P 4	VTL9A2/2	Photocell	VACTEC	3-50004
	TXBF2-032-036	Heatsink	IERC	3-90004
	1012002	Shield - Circuit Board	34160	1-10407

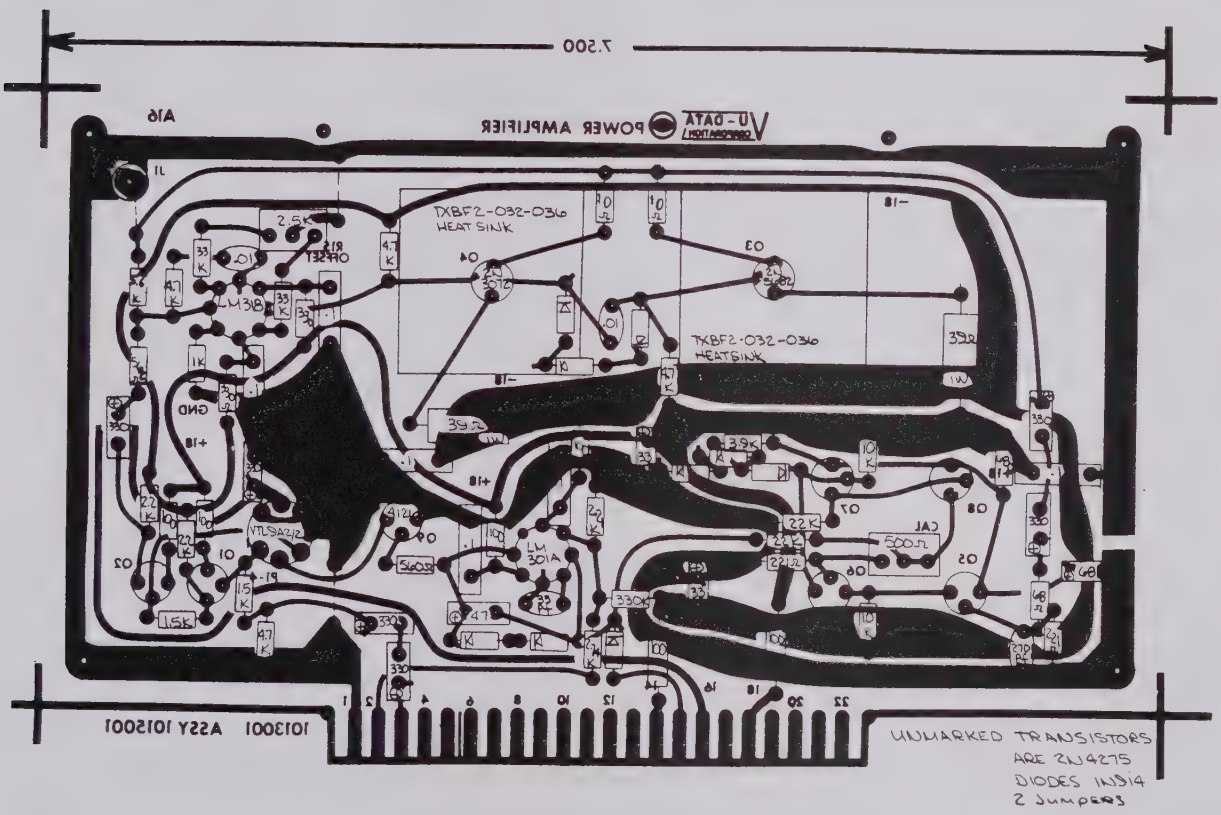
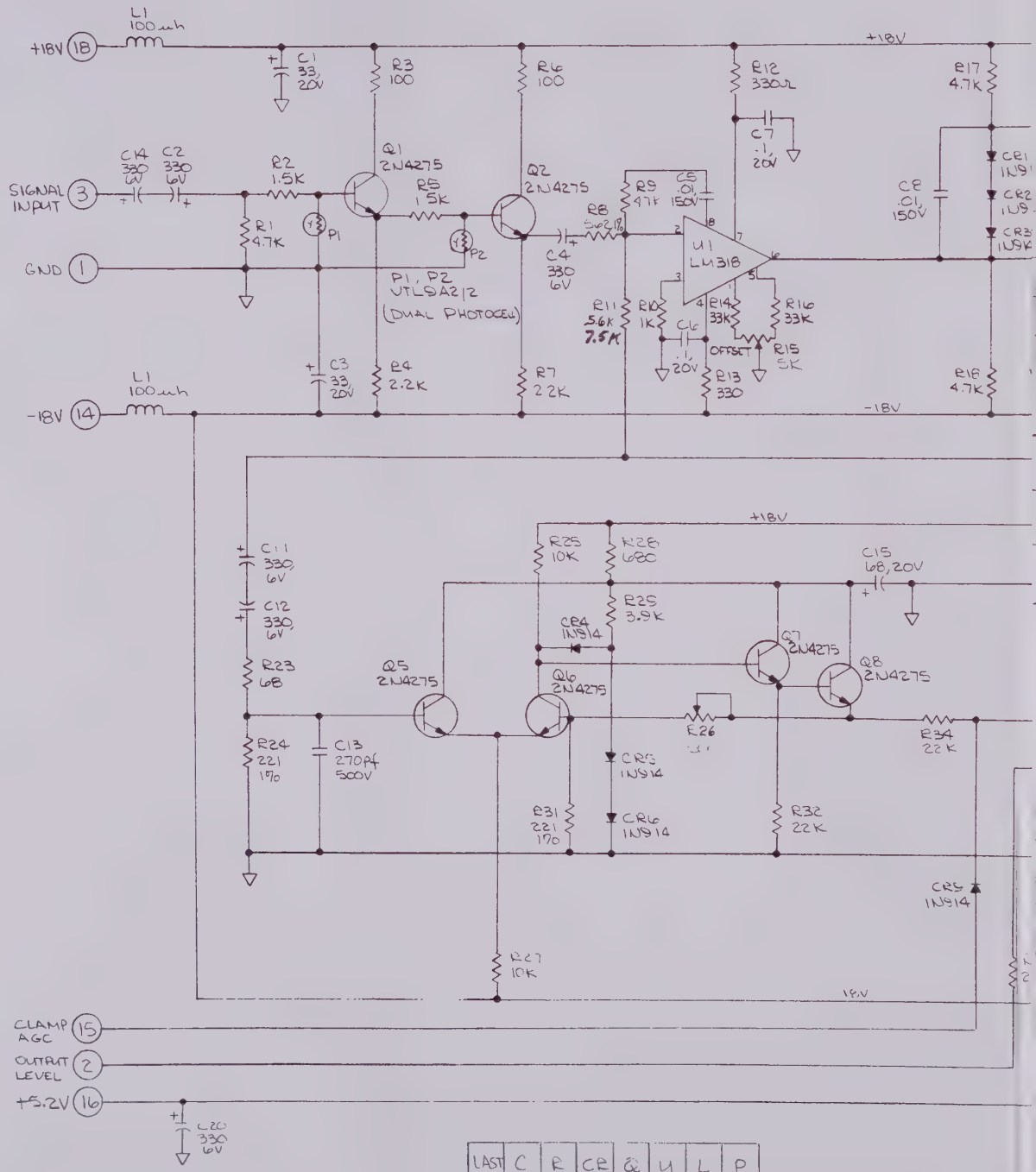


Fig. 6-21 Assembly A16 Parts Location

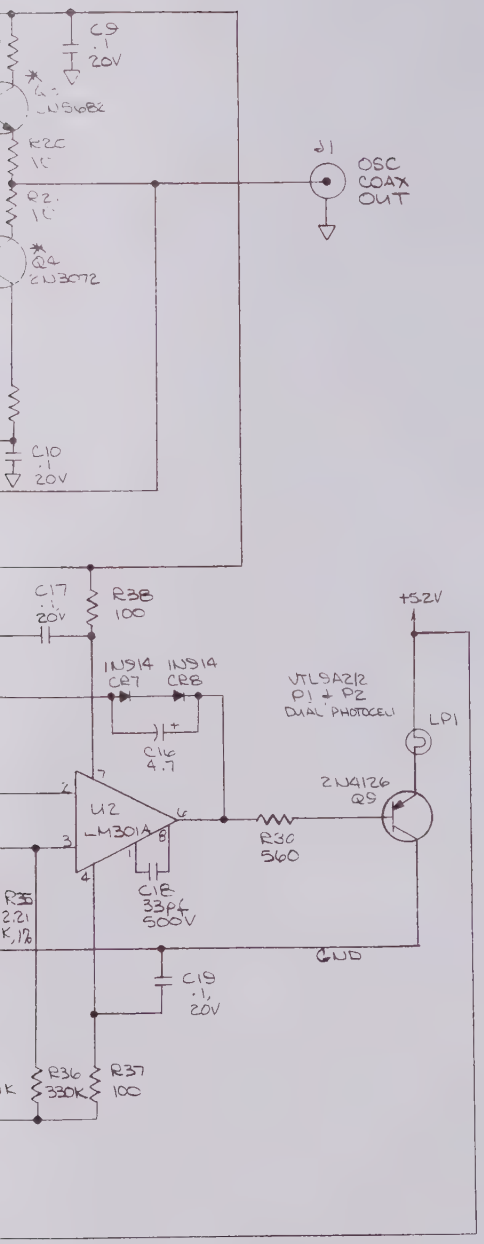
THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION WHICH MAY NOT BE DISCLOSED TO OTHERS REPRODUCED OR USED WITH OUT WRITTEN AUTHORITY FROM
VU-DATA CORPORATION



LAST	C	R	CR	Q	U	L	P
USED	15	35	5	5	2	2	4

3. * HEATSINK TXBF2-C32-C3K
2. CAPACITORS ARE IN μF
1. RESISTORS ARE 1/4W, 5% OHMS

NOTES: UNLESS OTHERWISE SPECIFIED



REVISIONS			
REV	DESCRIPTION	DATE	APPROVED

ITEM NO	QTY REQD	DESCRIPTION	SCHEM DES	VU-DATA PN	MIL OR VENDOR PN	CODE OR SPEC NO

LIST OF MATERIAL

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± DECIMALS .X ±.050
ANGLES ± .XX ±.030
SURFACE FINISH ✓ .XXX ±.010

MATERIAL: NONE

FINISH: NONE

PART NO	QTY REQD	NEXT ASSEMBLY	USED ON
			1015001

APPLICATION

CONTRACT NO.

DRAWN: Ogawa 8-8-72

CHECKED:

ENGINEER: 11-15-72

APPROVED: 16 Nov 72

APPROVED:

APPROVED:

CUSTOMER APPROVAL:

RELEASE: NOV 15 1972

VU-DATA CORPORATION — SAN DIEGO, CALIFORNIA

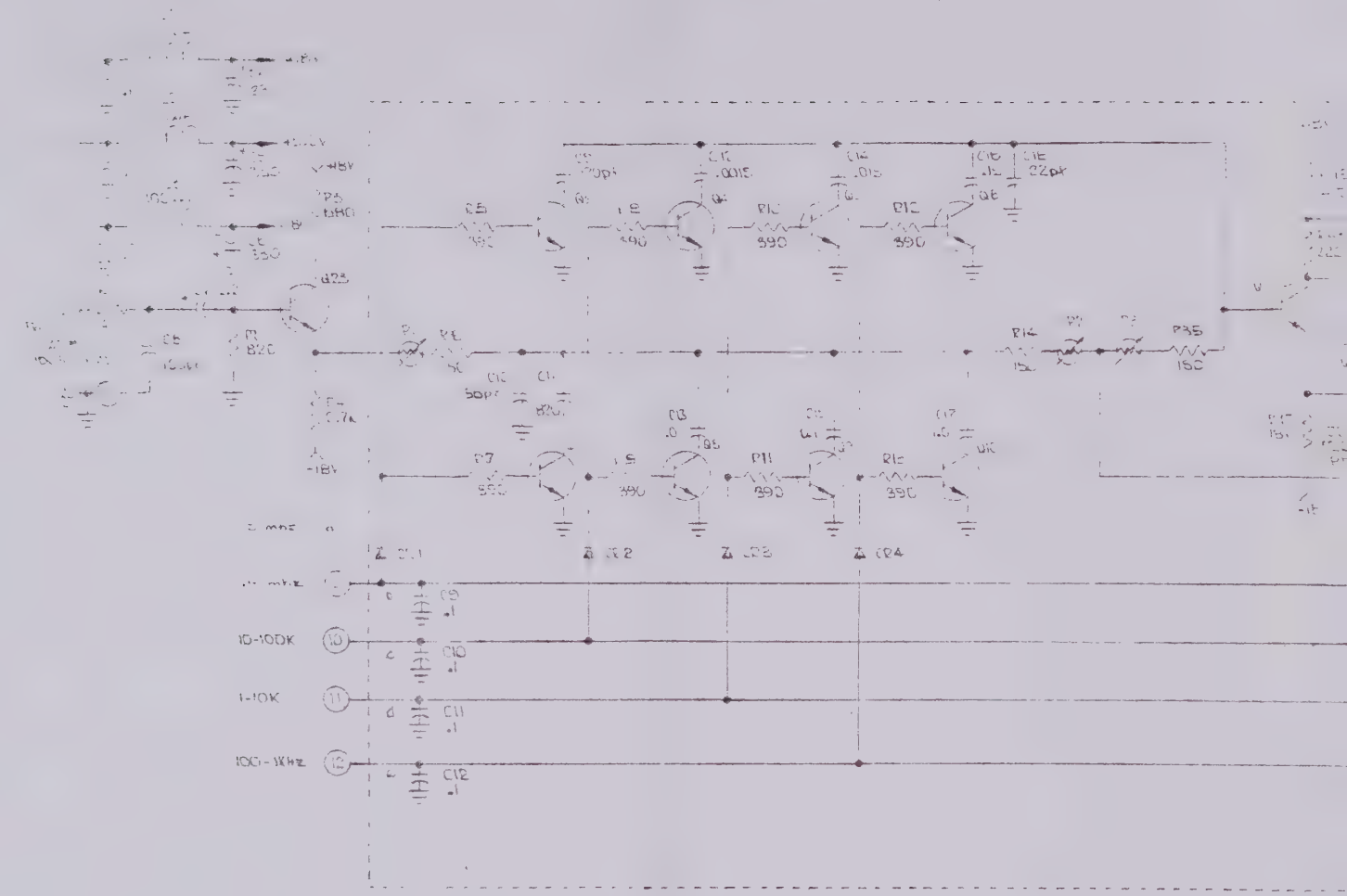
SCHEMATIC
POWER AMPLIFIER
A16

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	34160	1011001	

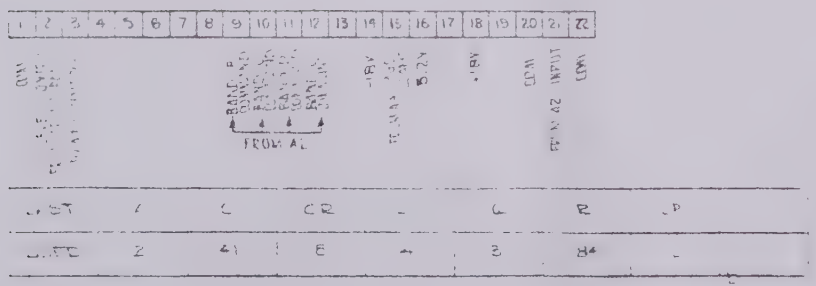
SCALE: NONE

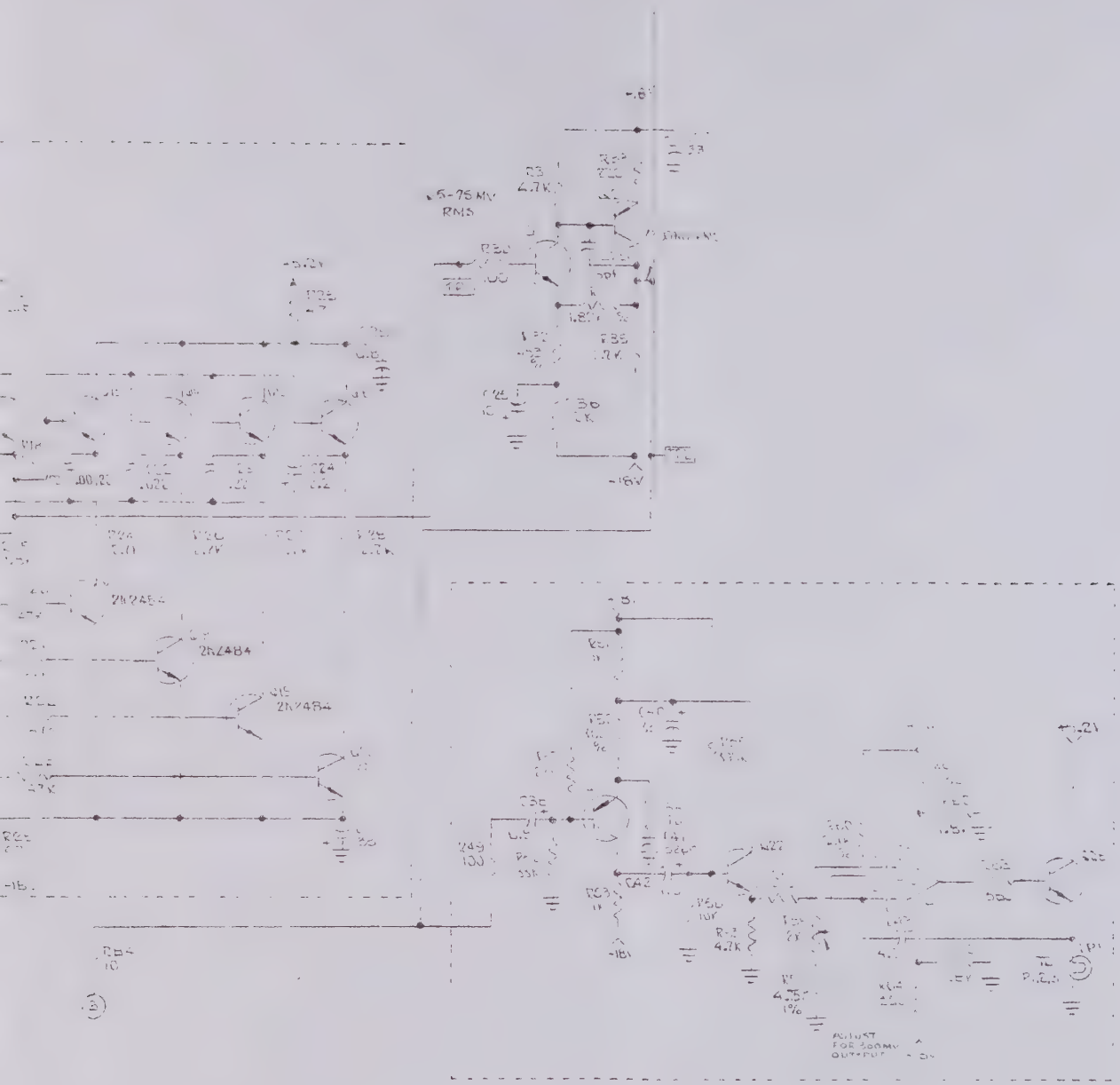
SHEET 1 OF 1

1011001



NOTE:
1. ALL NPN TRANSISTORS TYPE 2N4275 UNLESS MARKED
2. " PNP " " 2N4298 " "
3. " DIODES " " 1N3064 " "
4. ALL RESISTORS 5% 1/4W, COMP " "
5. " " VALUES IN OHMS " "
6. CAPACITOR " " MF " "



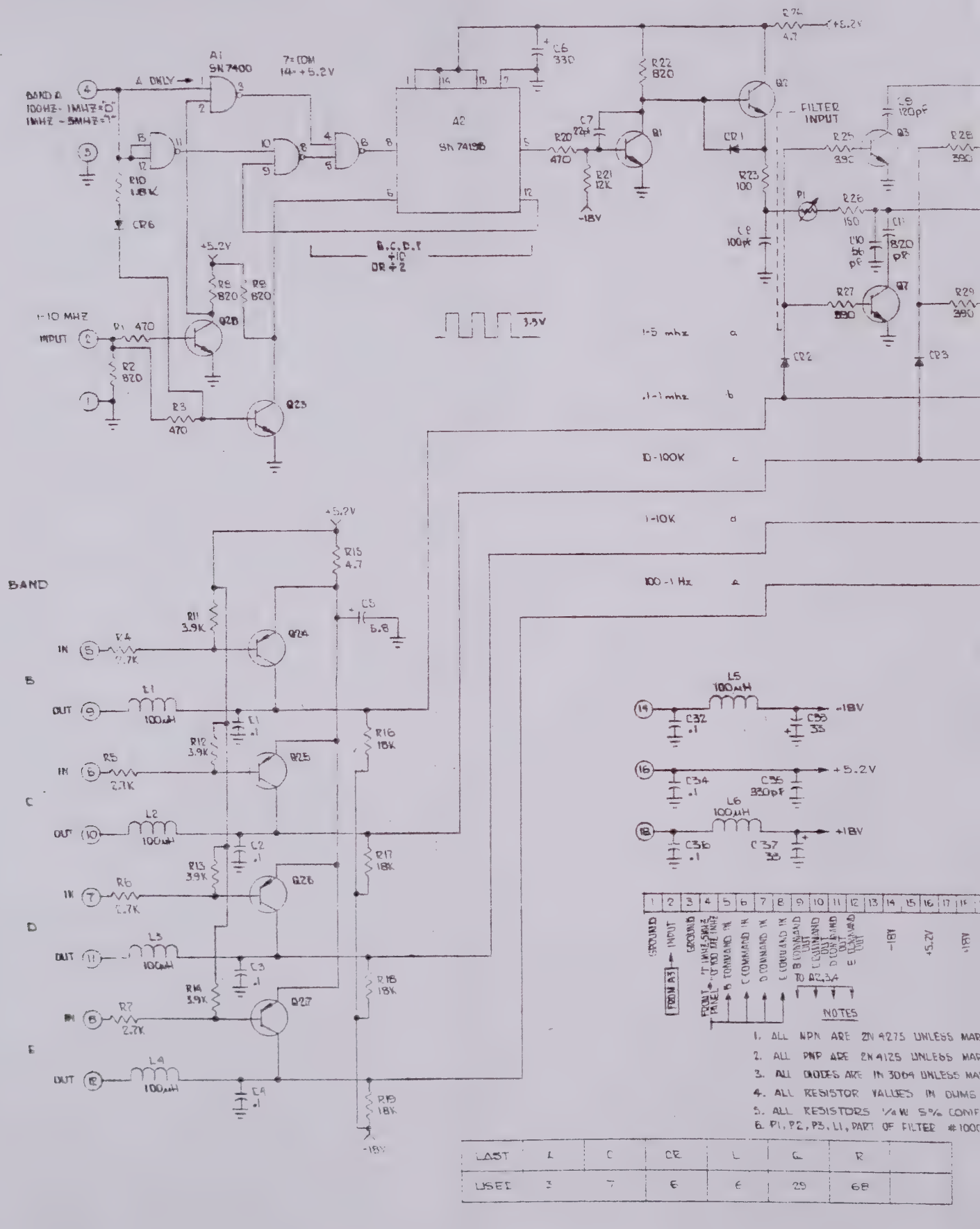


DRAWN	CHARLES KING	MAR 8.71
CHECKED		
APPROVED		

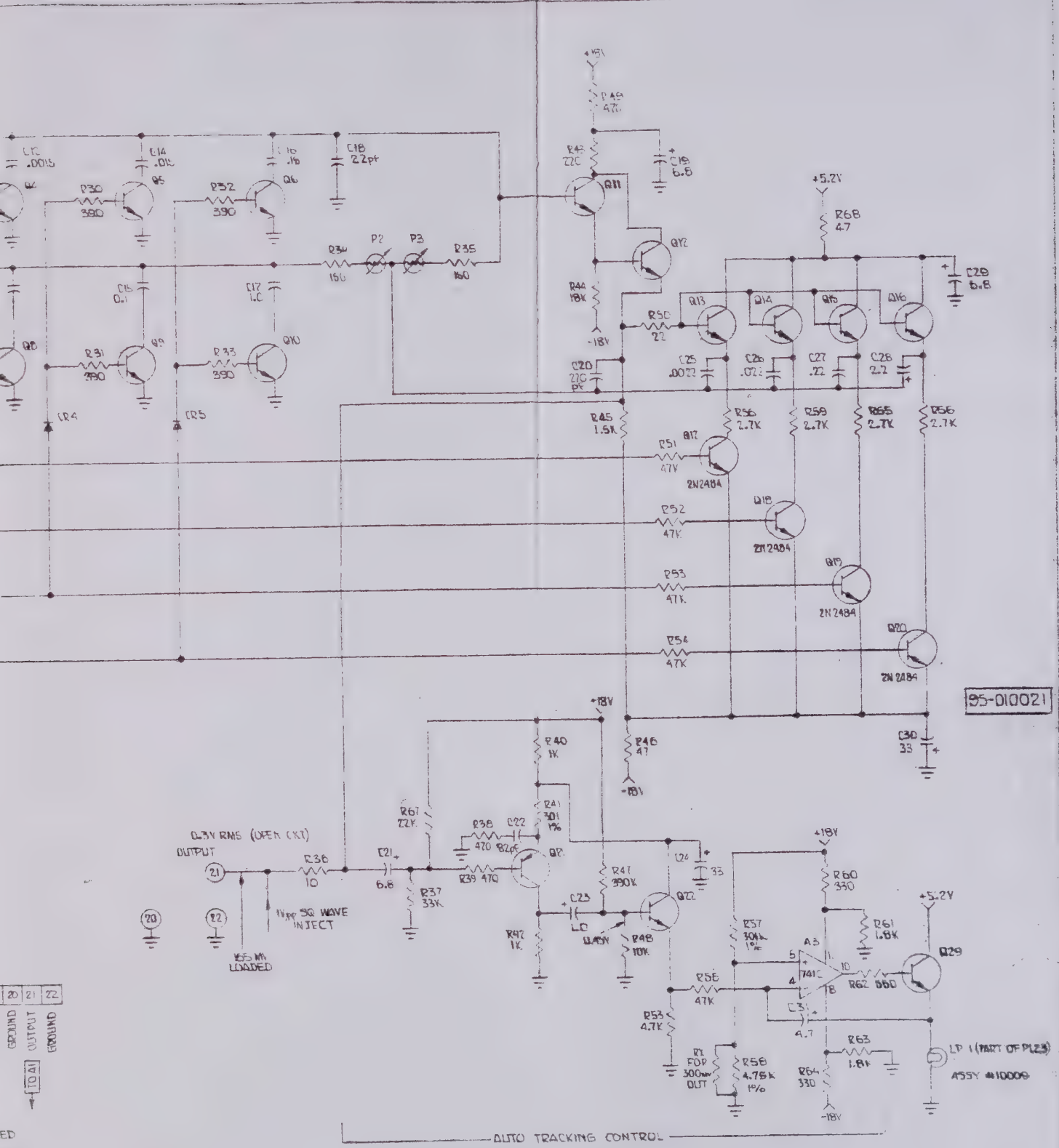
FUNDERLAND LABS, INC., SAN JOSE, CALIFORNIA

TITLE

TEST OSCILLATOR OUTPUT



LAST USED	A 3	C 7	CR 6	L 6	Q 29	R 68	



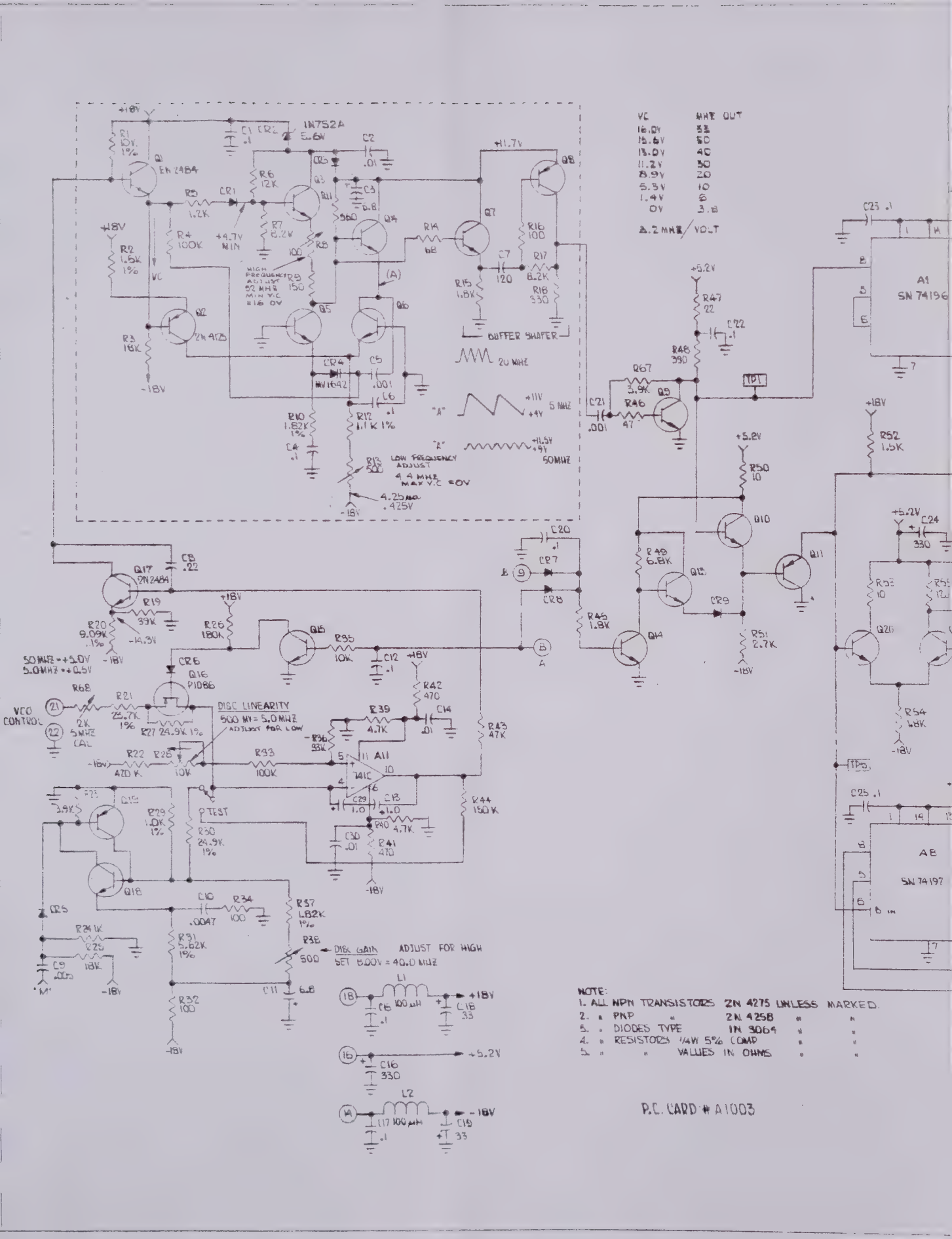
UNLESS MARKED

DRAWN	CHARLES KING	FEB 26.71
CHECKED		
APPROVED		

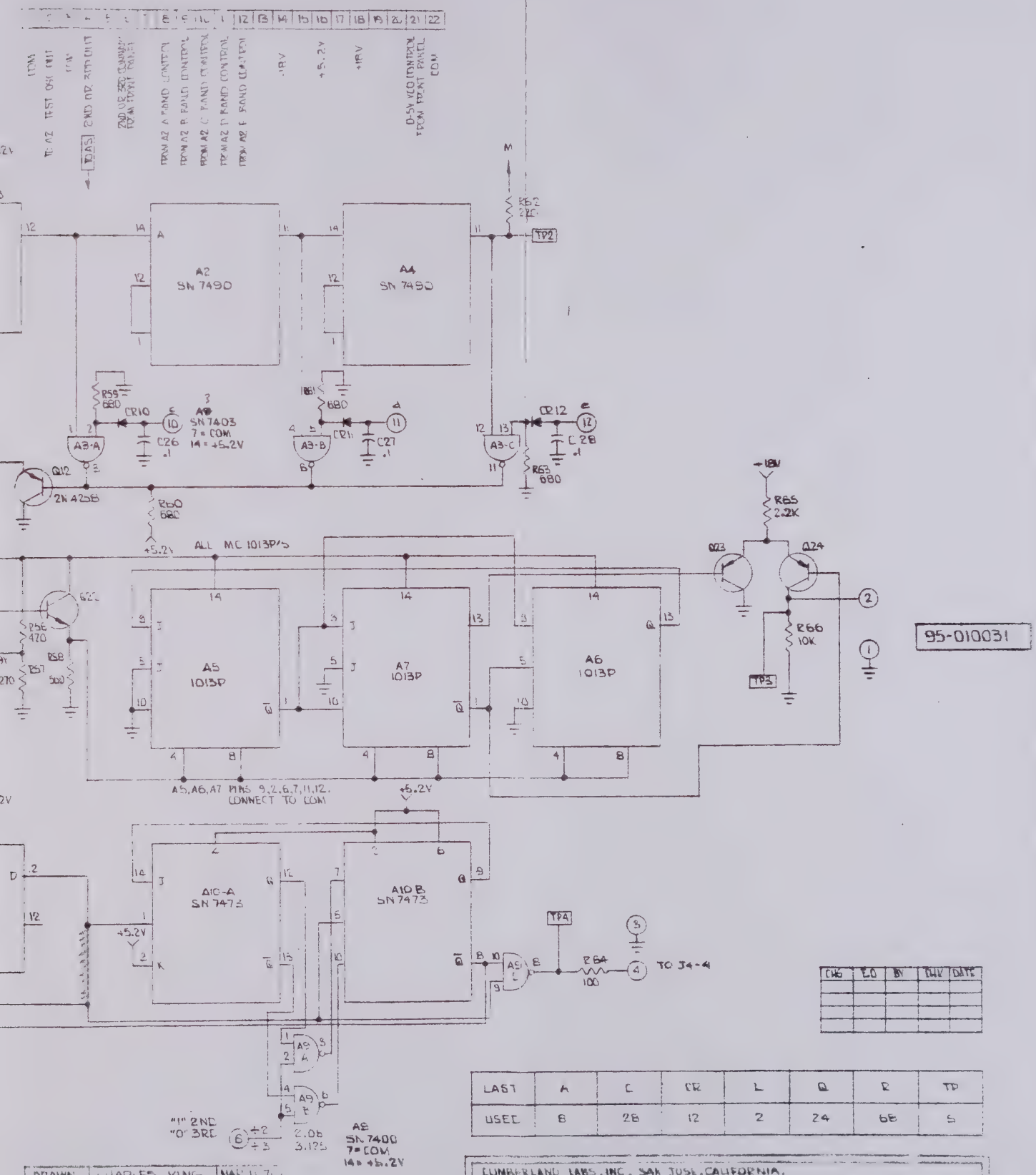
CUMBERLAND LABS, INC., SAN JOSE, CALIFORNIA

TITLE: TEST OSCILLATOR FILTER

DRW. NO. 95-010021



NOTE:
1. ALL NPN TRANSISTORS 2N 4275 UNLESS MARKED.
2. " PNP " 2N 4258 " "
3. " DIODES TYPE IN 3064 " "
4. " RESISTORS 1/4W 5% COMP " "
5. " " VALUES IN OHMS " "



CHG	E.O.	BY	CHK	DATE

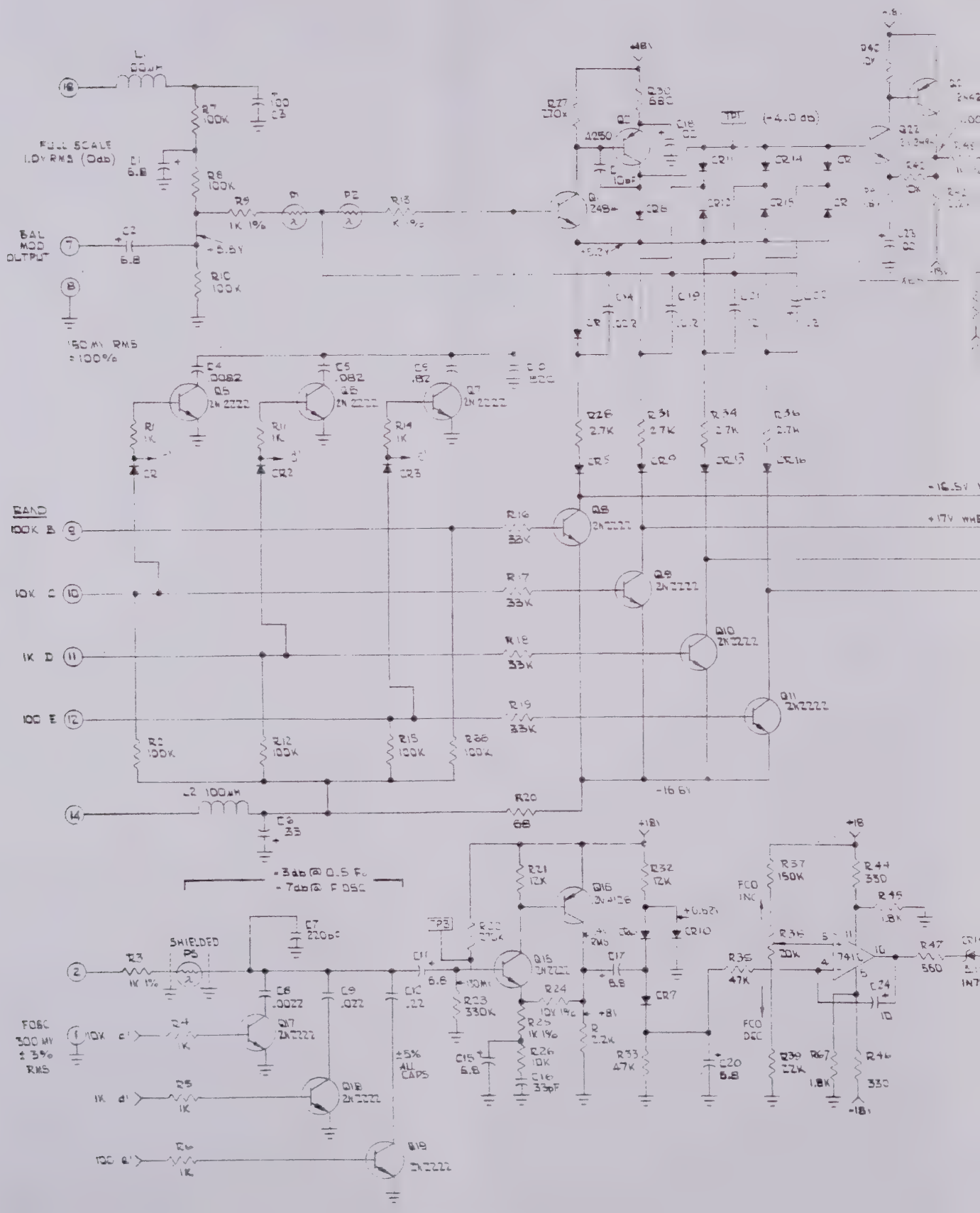
LAST	A	C	CR	L	Q	R	TP
USED	8	28	12	2	24	68	5

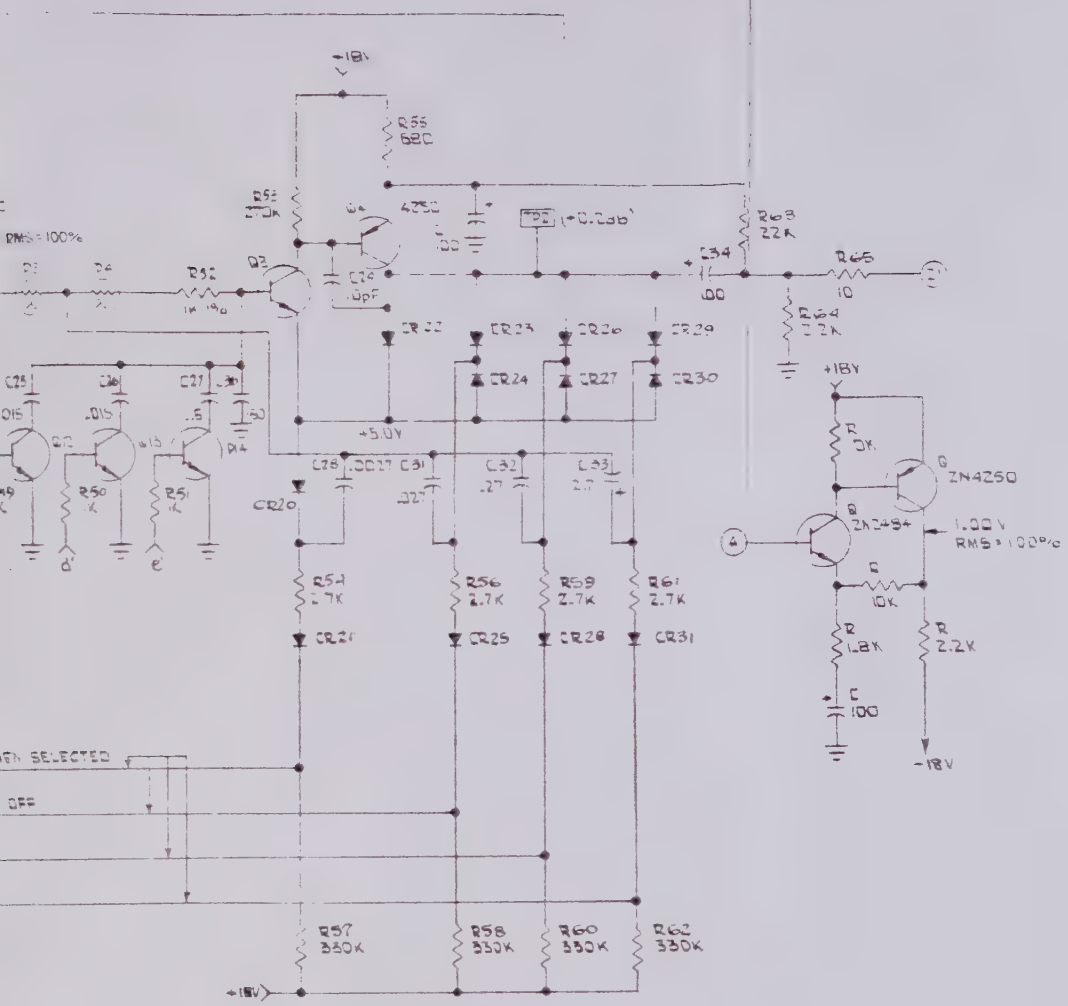
DRAWN	CHARLES KING	MAY 11,7
CHECKED		
APPROVED		

CUMBERLAND LABS, INC., SAN JOSE, CALIFORNIA.

TITLE: VCO - 50 MHZ CLOCK — A 2

DRW N°: 95-010031

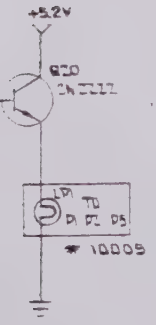

BAL MOD OUTPUT
FULL SCALE 1.0V RMS (0db)
150 MV RMS ±100%
BAND
100K B
10K C
1K D
100 E
FOSC 300 MV ± 3% RMS
SHIELDED
TBT
(-4.0 db)
FCO INC
FCO DEC
+18V
-16.5V
+17V
-16.6V
+3db @ 0.5 Fo
-7db @ F OSC
±5% ALL CAPS



95-0.004

NOTES

1. ALL DIODES IN4152
2. ALL CAPS LESS THAN 3.0 TOLERANCE ± 5%
3. SERIES R VARY FROM 1.33K TO 13.3K



CHG	E.O	BY	CHK	DATE

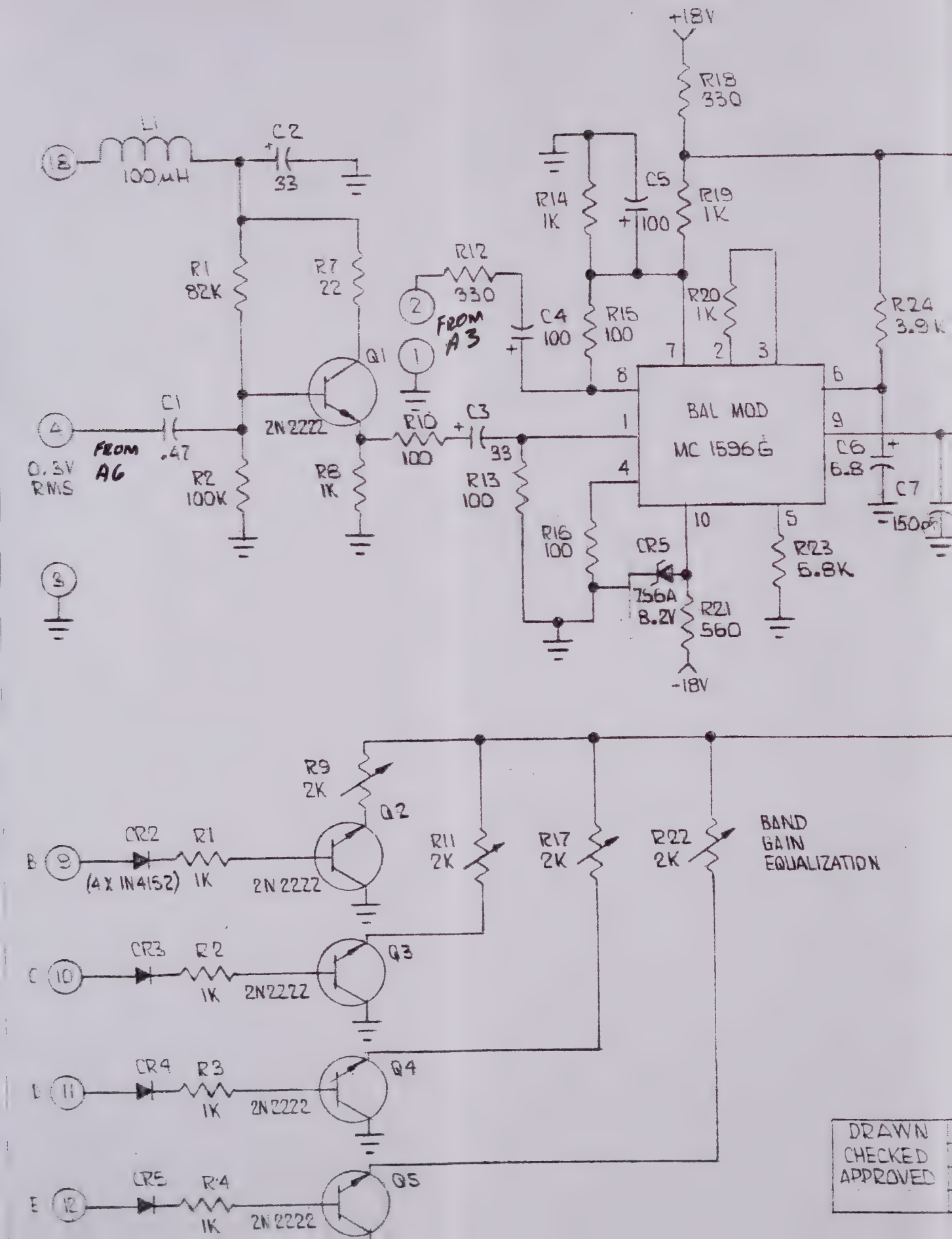
LAST	C	CR	-	LP	P	R	Q	TP
USED	34	31	2	1	3	67	22	3

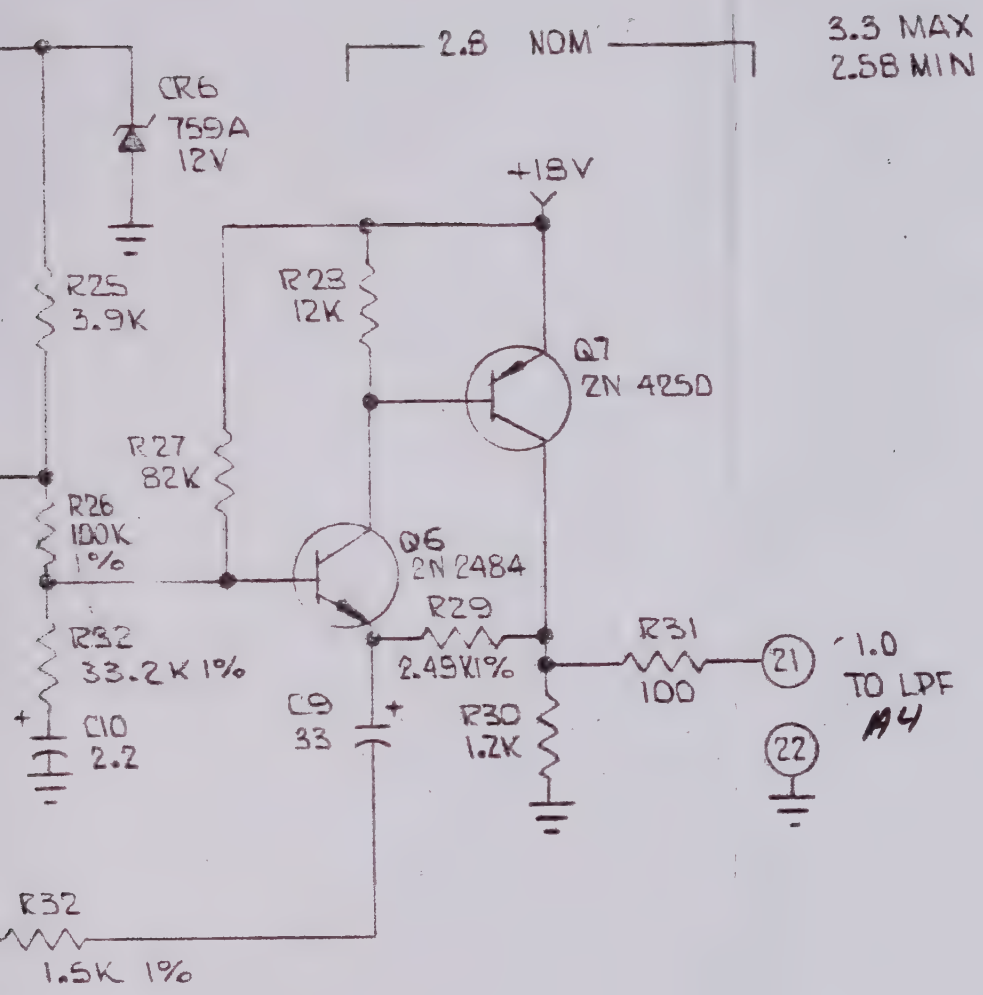
DRAWN	CHARLES KING	MAY 10 71
CHECKED		
APPROVED		

CUMBERLAND LABS, INC., SAN JOSE, CALIFORNIA

TITLE
TRACKING LPF BD 44

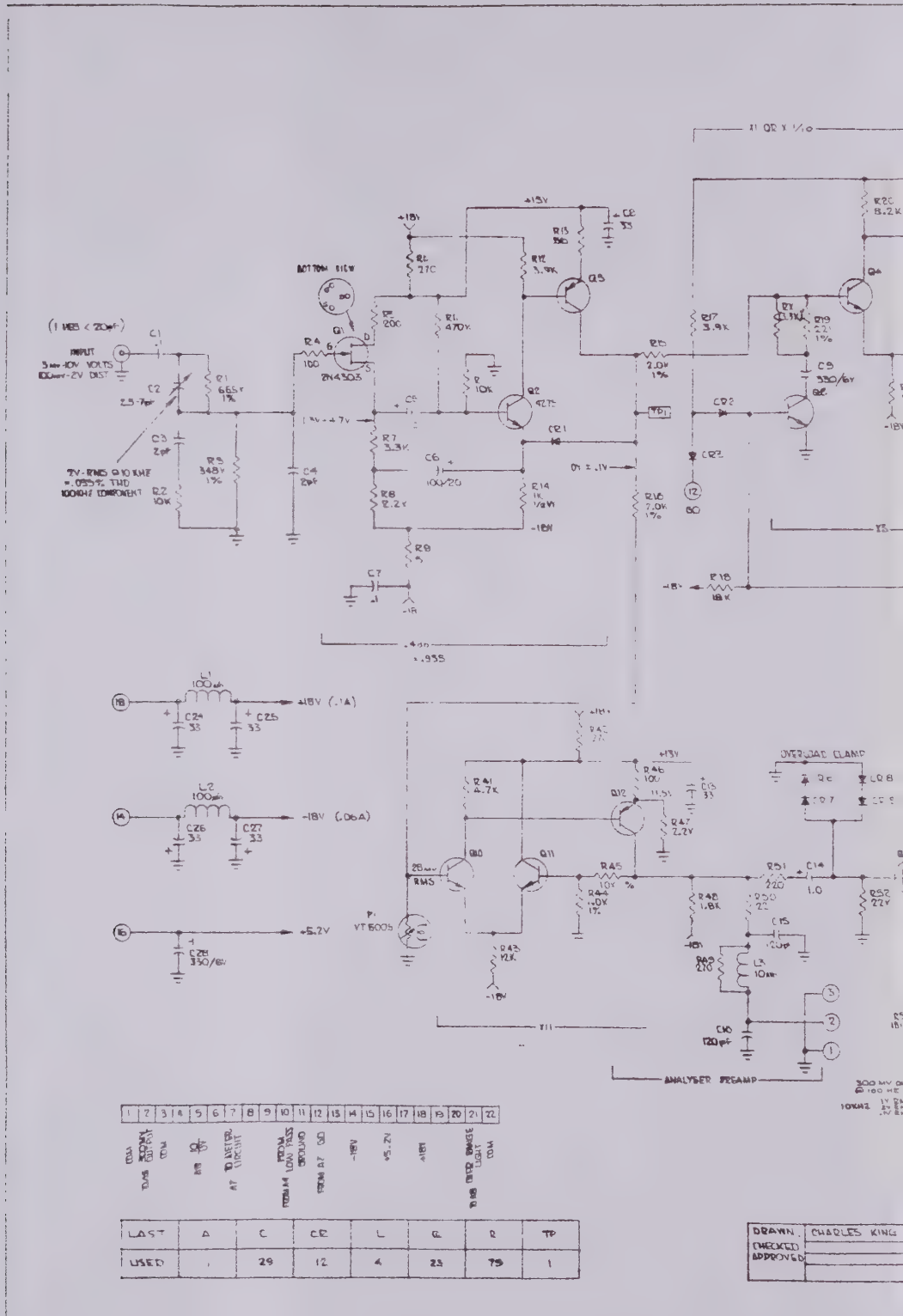
95-01004


+18V
R18
330
L1
100µH
C2
33
R14
1K
C5
100
R19
1K
R12
330
R1
82K
R7
22
FROM
A3
C4
100
R15
100
R20
1K
R24
3.9K
Q1
2N2222
BAL MOD
MC 1596G
C1
.47
FROM
A6
0.3V
RMS
R10
100
C3
33
R2
100K
R8
1K
R13
100
C6
6.8
C7
150pF
R16
100
CR5
756A
8.2V
R23
5.8K
R21
560
-18V
R9
2K
Q2
CR2
R1
(4 X IN4152)
1K
2N2222
R11
2K
R17
2K
R22
2K
BAND
GAIN
EQUALIZATION
CR3
R2
1K
2N2222
Q3
CR4
R3
1K
2N2222
Q4
CR5
R4
1K
2N2222
Q5
DRAWN
CHECKED
APPROVED



CHARLES KING	8.3.71

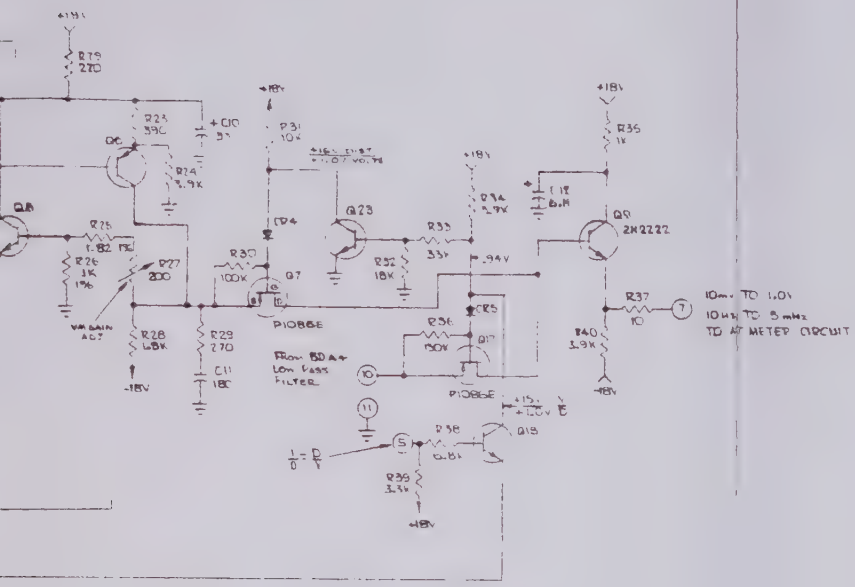
CUMBERLAND LABS, INC, SAN JOSE, CALIFORNIA.	
TITLE: MODULATOR A5	DWG NO 9 1005-1



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
COM	TO RANGE SWITCH	COM			TO METER CIRCUIT			FROM LOW PASS	GROUND		FROM A7	GND		-18V		+5.2V		+18V		TO 18B	METER RANGE LIGHT	COM

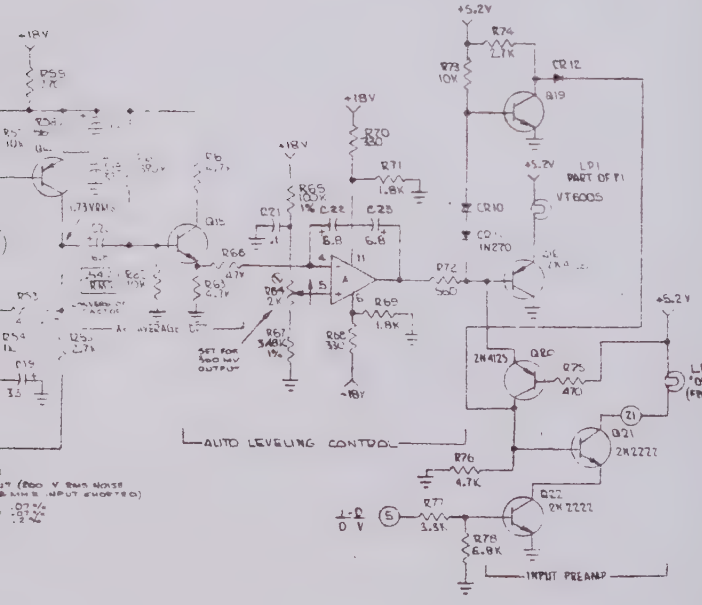
LAST	A	C	CE	L	GL	R	TP
USED	1	29	12	4	23	75	1

DRAWN	CHARLES KING
CHECKED	
APPROVED	



VM DIST MODE GATING

95-010061

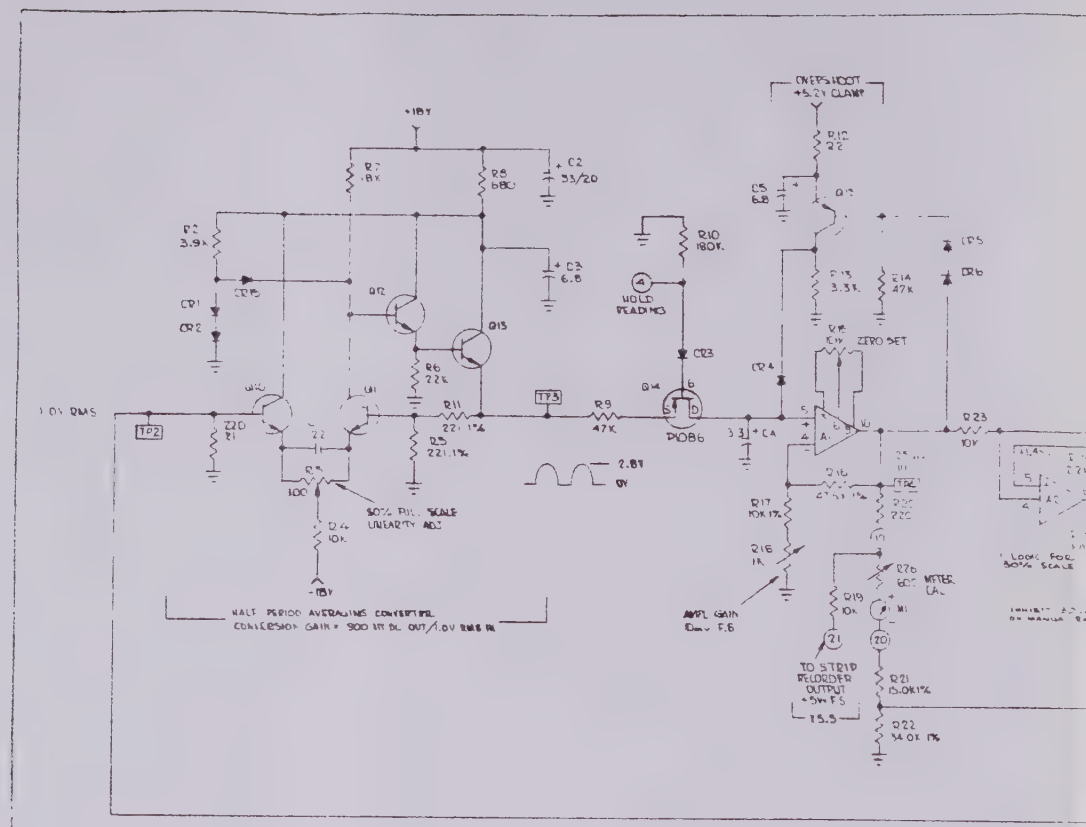


UNLESS NOTED
1. ALL NPN 2N 4275 UNLESS MARKED
2. ALL PNP 2N 4126 UNLESS MARKED
3. ALL DIODES IN3064 UNLESS MARKED
4. ALL RESISTORS ¼W, 5% UNLESS MARKED

CHG	ECO	BY	CHK	DATE

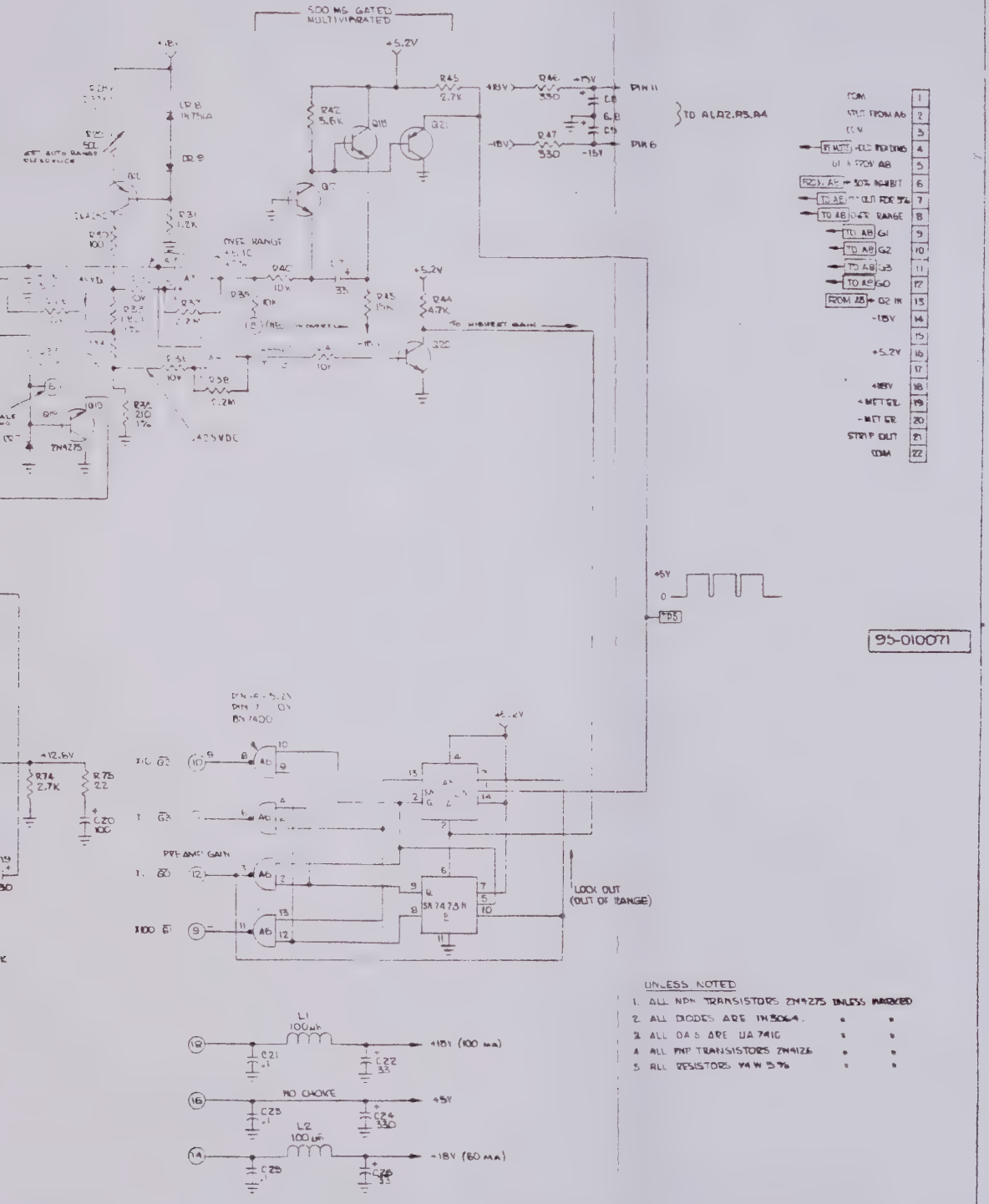
CUMBERLAND LABS, INC., SAN JOSE, CALIFORNIA.

TITLE		DRW NO
INPUT PREAMP	A 6	95-010061



LAST	A	C	CR	L	Q	R	TP
USED	6	26	15	2	21	76	8

DRAWN	CHARLES
CHECKED	
APPROVED	



UNLESS NOTED

1. ALL NPN TRANSISTORS ZN9275 UNLESS MARKED
2. ALL DIODES ARE IN3064. " "
3. ALL OA'S ARE UA 7416 " "
4. ALL PNP TRANSISTORS ZN9126 " "
5. ALL RESISTORS ¼W 5%. " "

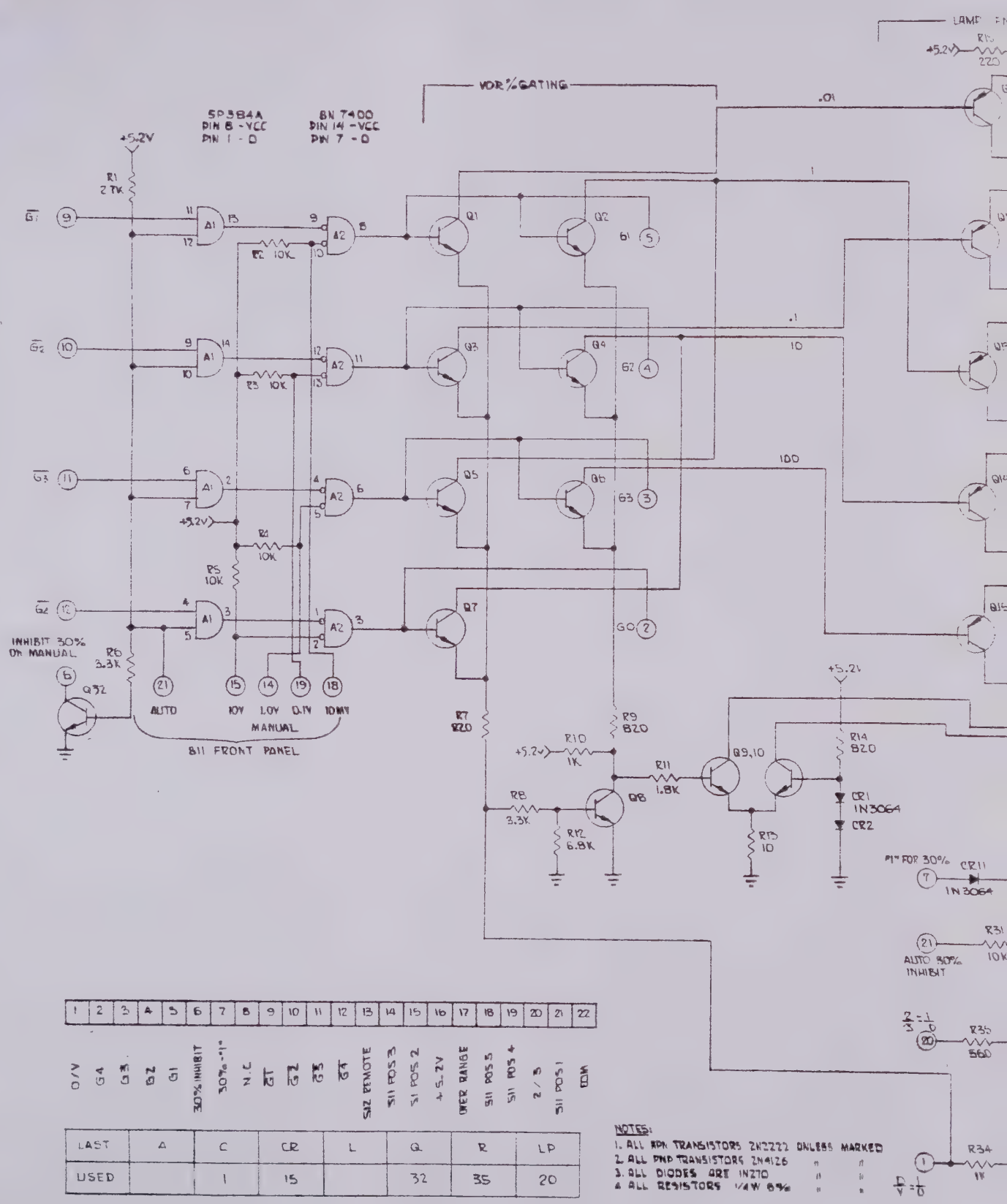
	DATE

CUMBERLAND LABS, INC. LOS GATOS, CALIFORNIA.

TITLE AMPLIFIER - METER - AUTO RANGE A7

DRW № 95-010071

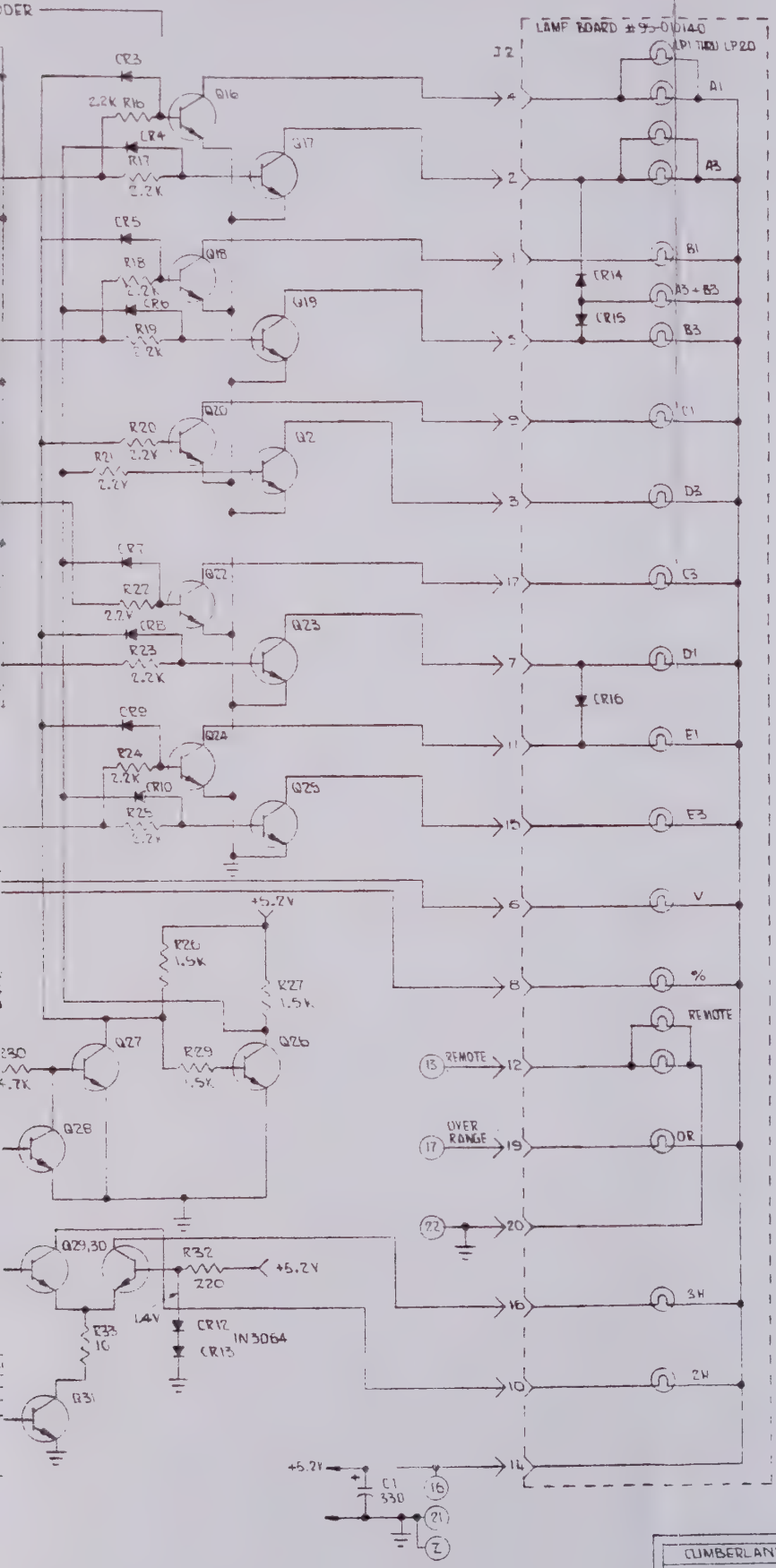
O. L



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
D/V	G4	G3	G2	G1	30% INHIBIT	30%-1"	N.C	ST	G2	G3	G4	SW2 REMOTE	SW POS 3	SW POS 2	+5.2V	OVER RANGE	SW POS 5	SW POS 4	2 / 3	SW POS 1	COM

LAST	A	C	CR	L	Q	R	LP
USED		1	15		32	35	20

NOTES:
1. ALL NPN TRANSISTORS 2N2222 UNLESS MARKED
2. ALL PNP TRANSISTORS 2N4126 " "
3. ALL DIODES ARE IN270 " "
4. ALL RESISTORS 1/4W 5% " "



GAIN TABLE				
DIST	VM	A1	A2	A3
1%	.01V	10	10	10
10%	.1V	10	10	1
100%	1V	10	1	1
-	10V	1	1	1

95-010081

CHG	E.O	BY	CHK	DATE

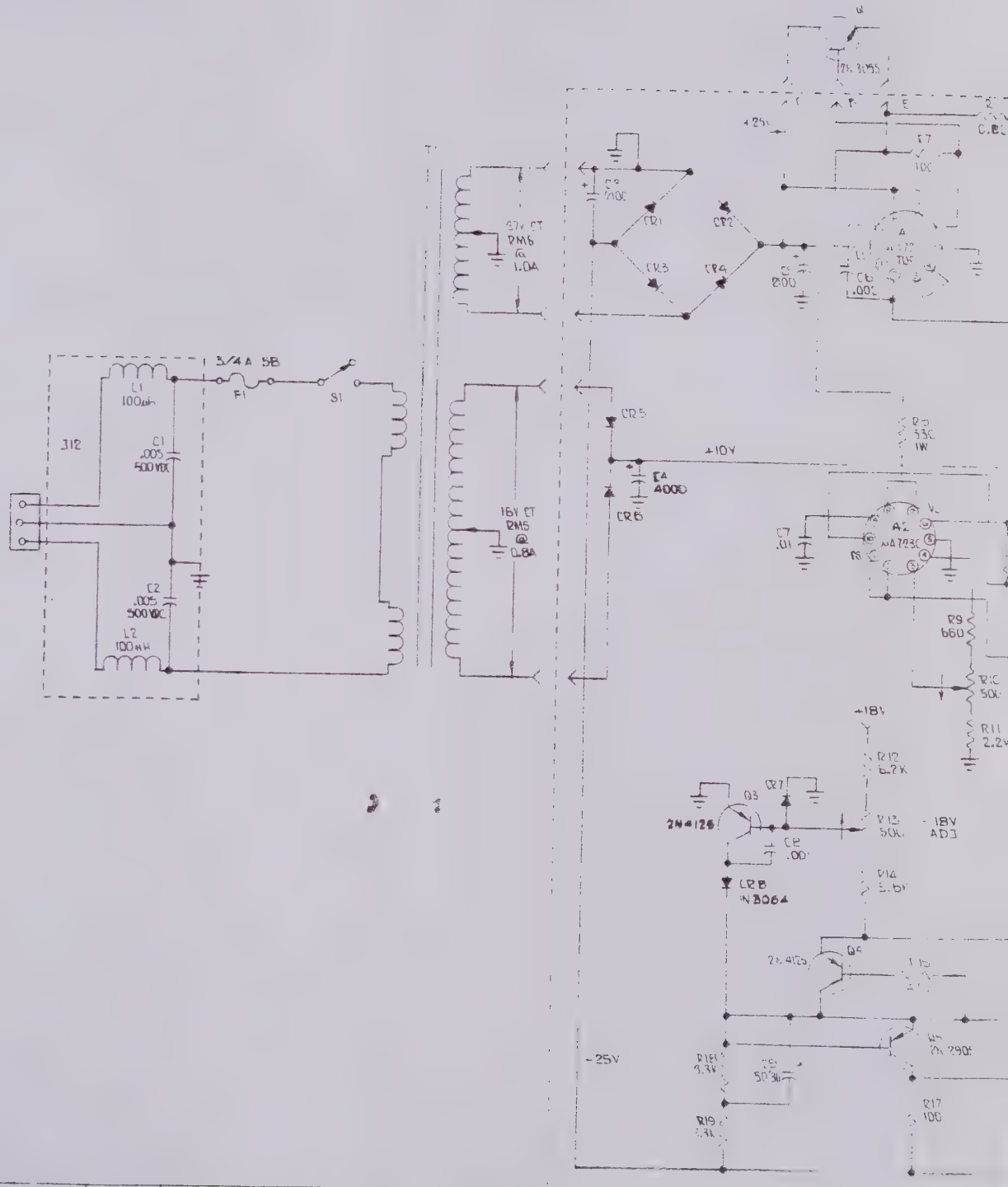
LAMP IDENTIFICATION							
-	-	.0 A1	. B1	1 C1	0 D1	0 E1	UPPER
.0 A3	. B3	0 A3B3	. C3	3 D3	0 E3	-	LOWER

DRAWN	CHARLES KING	MAY 6 71
CHECKED		
APPROVED		

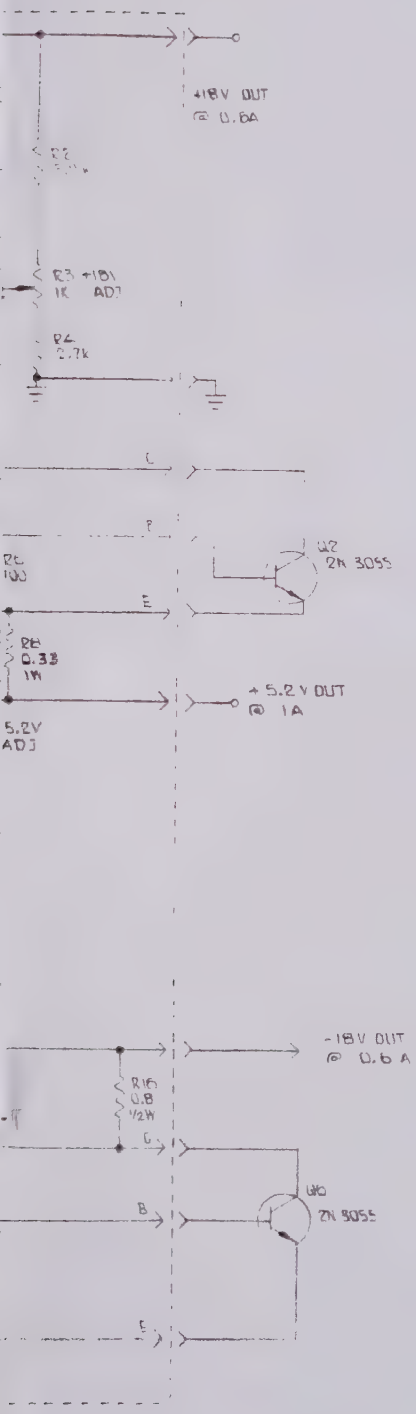
CUMBERLAND LABS INC. SAN JOSE, CALIFORNIA

EXECUTIVE PROGRAMMER

DRW NO 95-010081



LAST	A	C	CR	L	Q	R	T
USED	2	5	8	2	2	19	



NOTE

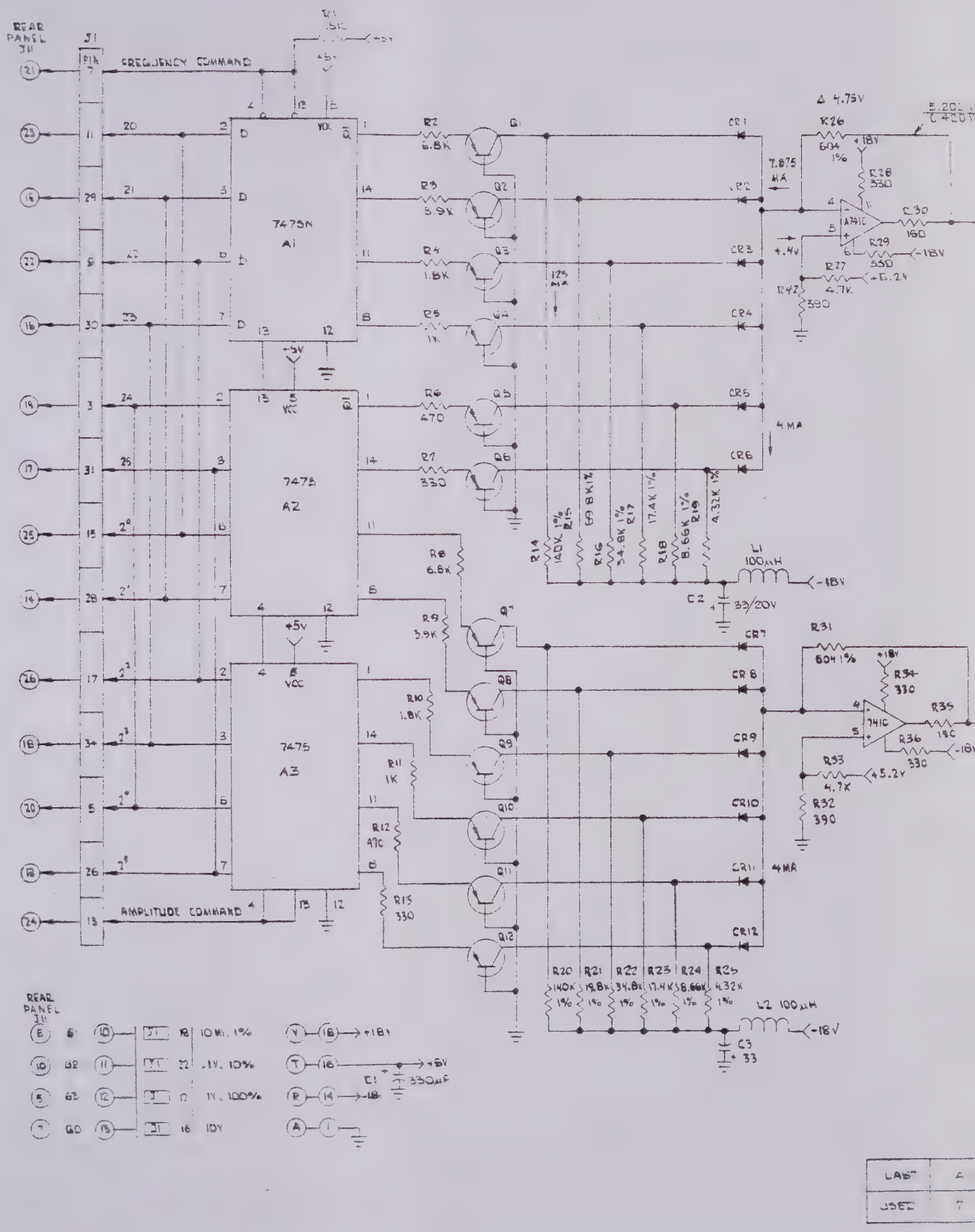
1. ALL DIODES IN4003 UNLESS MARKED
2. ALL RESISTORS 1/4W 5% UNLESS MARKED

DRAWN	CHARLES WING	FEB 25.71
CHECKED		
APPROVED		

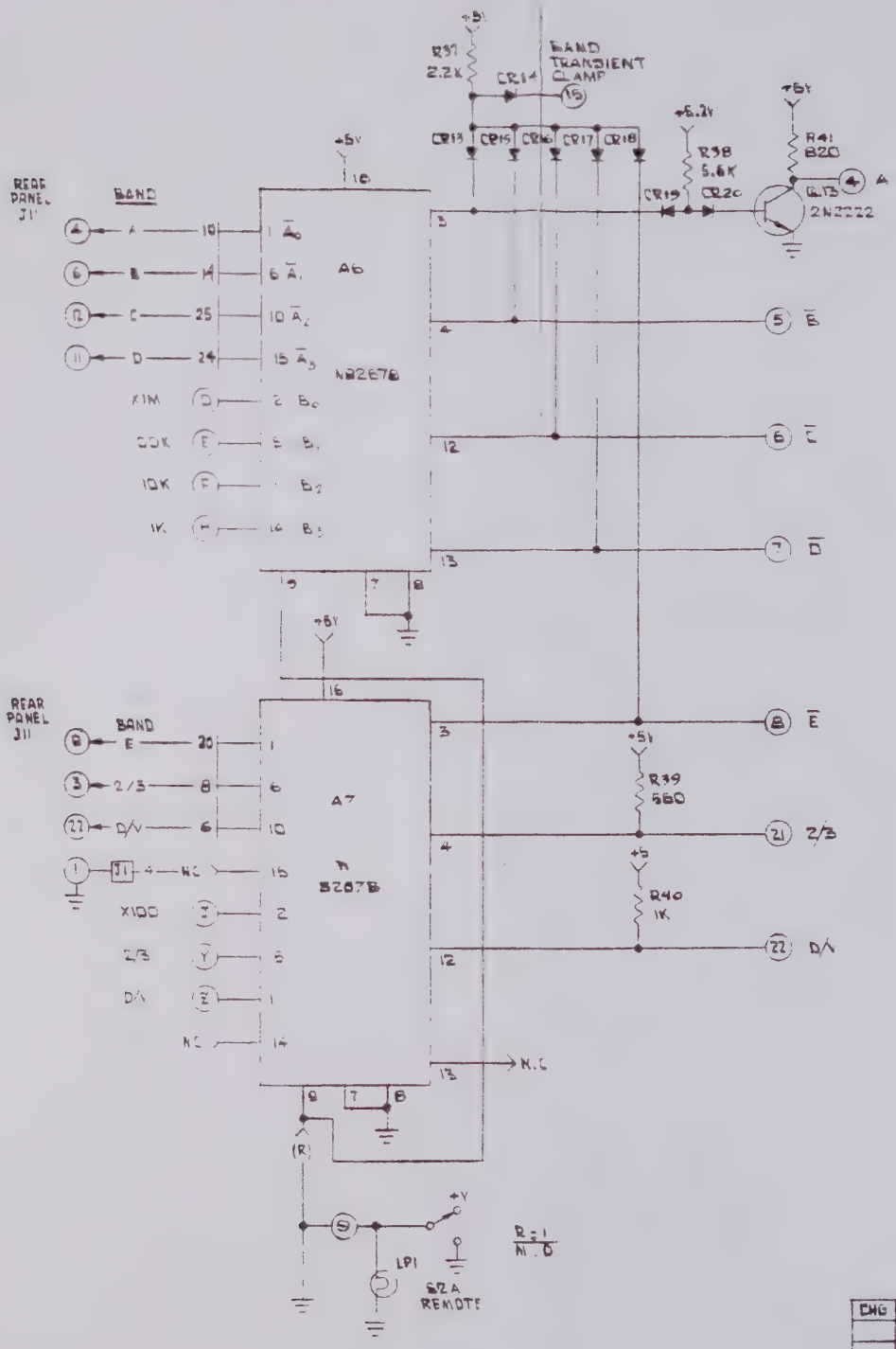
CHG	E C	P	INK	DATE

CUMBERLAND LABS, INC., SAN JOSE, CALIFORNIA.

TITLE	DRV. N°
POWER SUPPLY A/C	95-010101


REAR PANEL J1
J1 PIN
FREQUENCY COMMAND
AMPLITUDE COMMAND
7475N A1
7475 A2
7475 A3
R1 1.5K
+5V
R2 6.8K
R3 3.9K
R4 1.8K
R5 1K
R6 470
R7 330
R8 6.8K
R9 3.9K
R10 1.8K
R11 1K
R12 470
R13 330
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
CR9
CR10
CR11
CR12
4 MA
125 MA
Δ 4.75V
7.875 MA
+4.4V
R26 604 1%
R28 330
R30 160
R29 550
R27 4.7K
R42 390
+18V
-18V
+5.2V
741C
R14 140K 1%
R15 69.8K 1%
R16 34.8K 1%
R17 17.4K 1%
R18 8.66K 1%
R19 4.32K 1%
L1 100μH
C2 33/20V
R31 604 1%
R34 330
R35 160
R33 4.7K
R32 390
R20 140K 1%
R21 69.8K 1%
R22 34.8K 1%
R23 17.4K 1%
R24 8.66K 1%
R25 4.32K 1%
L2 100μH
C3 33
C1 330μF
REAR PANEL J1
10 MS, 1%
.1V, 10%
1V, 100%
10V
+18V
+5V
-18V

LAB	A
USED	7



95-010121

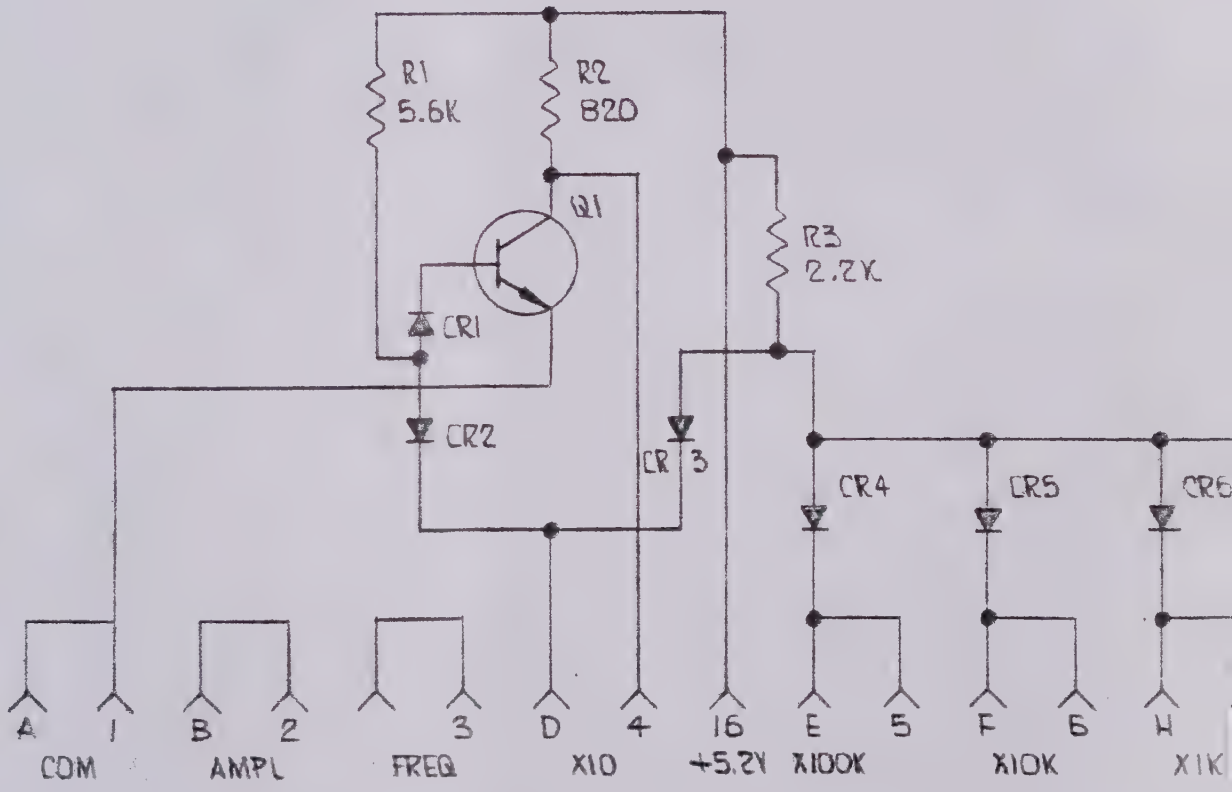
CHG	EO	BY	CHK	DATE

DRAWN	CHARLES KING	10 MAY 71
CHECKED		
APPROVED		

C	CR	L	LP	R	Q
3	20	2	1	42	13

CUMBERLAND LABS, INC., SAN JOSE, CALIFORNIA

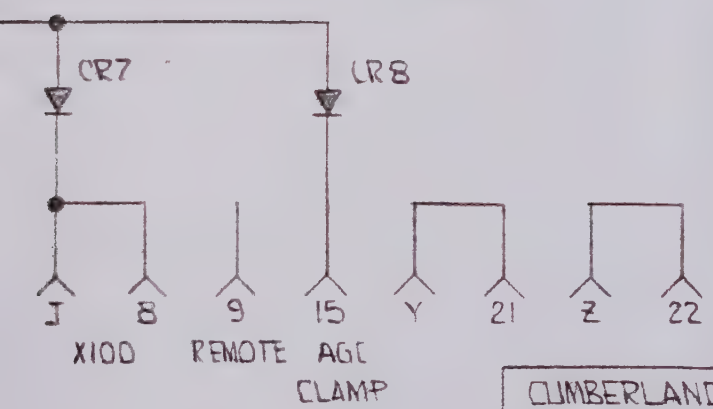
REMOTE LOGIC BOARD A0 | 95-010121


R1
5.6K
R2
820
Q1
R3
2.2K
CR1
CR2
CR3
CR4
CR5
CR6
A
1
COM
B
2
AMPL
3
FREQ
D
4
X10
16
+5.2V
E
5
X100K
F
6
X10K
H
X1K

CHG	E.O	BY	CHK	DATE

P C CARD
1013

DRAWN	CHARLES KING	MAY 6 71
CHECKED		
APPROVED		



CUMBERLAND LABS. INC., SAN JOSE, CALIFORNIA	
REMOTE JUMPER CARD	95-010131

Low-Pass Filter (LPF) (Board A4)

A low-pass Chebyschev 4-pole filter that is automatically tracked to the test oscillator frequency, this circuit filters out the offset frequency (ref. ckt. description Bd A3) coming from the balanced modulator. (The offset frequency is proportional in amplitude to the amount of second or third harmonic distortion in the signal under test). The resultant filtered signal is fed to the input conditioning Bd A6 and then to the meter drivers A7.

The test oscillator signal level is automatically held to 300 mV $\pm$ 2% by the A1 board and is fed through a single-pole low-pass filter into the automatic tracking control (ATC) circuit in Bd A4. This circuit is identical to the ATC circuits used in Bd A1 and Bd A2. Photocell P5 is shielded to prevent mixing of the test oscillator frequency and the offset frequency, which is -7 dB down. Pot R38 is adjusted so that the LPF is -3 dB down at the oscillator frequency. Accurate attenuation of the test oscillator frequency is accomplished by switching in solid-state switches Q17, Q18, and Q19 for Bands c, d, and e, respectively. These bands are controlled by the band switches located on Bd A2.

With the addition of a gain-of 10 amplifier, Q21 and Q22, the LPF is identical to the oscillator shaper circuits on Bds A1 and A2. The LPF is tuned to give a flat response when the offset frequency is 0.16 of the test oscillator frequency.

Balanced Modulator (Board A5)

The purpose of this board is to mix the input signal with the signal from the clock board (A3). The frequency of the latter signal is two or three times the fundamental frequency plus an offset frequency, depending on whether the 2H or the 3H button is pressed. By mixing these frequencies it is possible to receive an offset frequency that is proporational in amplitude to the second or third harmonic content of the signal under test.

The signal to be tested is derived from Bd A6, where it was automatically normalized to 300 mV, and enters Bd A5 at Pin 4. It then passes through emitter-follower Q1 to Pin 1 of the balanced modulator. The square wave from Bd A3 enters the balanced modulator at Pin 8 where it is mixed internally, and the resulting outputs are received at A4.

The basic element of the demodulator is A1, a doubly balanced demodulator which permits near ideal extraction of the harmonics of the test signal. Suppression of the original test signal and the mixer local oscillator signal is very high owing to the doubly balanced configuration. The output of the demodulator is primarily the sum and difference of the test signal and the mixer local oscillator signal. Since the sum frequency is considerably higher than the difference, the desired signal difference can be easily extracted with a low-pass filter of modest performance requirements. This difference signal, or offset frequency, is fed to LPF Bd A4 where the sum frequency and other minor residual demodulator products are removed. A four pole Chebishev 0.1 dB characteristic filter is used to reduce all unwanted products to a level at least 58 dB below the desired offset frequency.

The signal is then processed through an amplifier buffer where the gain is equalized for different band operation by R9, R11, R17, and R22, which are switched in by solid-state switches Q2, Q3, Q4, and Q5, respectively. The output is sent to low-pass filter A4. Here the correct frequency is filtered and sent to the meter drivers.

Input Conditioning Circuit (Board A6)

Two separate amplifier systems are provided in Bd A6 to meet the different needs of the voltmeter (V mode) and harmonic analyzer (2H or 3H mode). In the V mode, an accurate preamplifier (Q4, Q5, and Q6) preceded by a programmable 10-to-1 attenuator Q8 handles the three decade plus input signal range. In the 2H or 3H mode, a preamplifier Q10, Q11, and Q12) with a gain of 11 followed by an auto-leveling control circuit, allows constant output (300 mV) to drive the Harmonic Extractor Circuit. Both preamplifiers must maintain a flat frequency response from 10 Hz to 5 MHz. The output of the V mode preamplifier is fed to a precision FET Q7 prior to driving the Auto-Ranging Circuit. In the 2H or 3H mode, this FET opens the V mode preamplifier path and permits the resultant harmonic extractor products to drive the Auto-Ranging Circuit through Q17.

Q1, the FET buffer, and transistors Q2 and Q3, the unity-gain feedback amplifier, convert the 1 MΩ input impedance to a negligibly low impedance for driving the V mode and 2H or 3H mode preamplifiers. The frequency-compensated attenuation network (C1, C2, C3, R2, etc.) at the input limits the input level in the V mode to maintain gain linearity at the upper frequencies. In addition, the large resistive input provides complete protection agains excessive input levels. Gain error due to loading of the FET output is eliminated by unity-gain bootstrap feedback via capacitor C6.

The preamplifier in the harmonic analyzer mode is included in a high-gain auto-leveling loop to maintain a constant 300 mV rms output over a 20-to-1 input amplitude range while at the same time introducing a small amount of distortion. The input to this preamplifier is held to a constant 28 mV

by photocell resistor P1. Control for P1 is derived by amplifying the X11 output (transistors Q13 and Q14) to about 1.7 V rms and half-wave rectified by transistor Q15. Operational amplifier A1 averages the rectified level to drive lamp driver transistor Q16. Closed loop operation is as follows: Assume the output level exceeds the normal level of 300 mV. After averaging, the output of integrator A1 goes in a negative direction, increasing the lamp intensity. The photocell resistance decreases, the X11 amplifier input level is reduced, and the output level is restored to its nominal 300 mV level.

As long as the photocell lamp voltage can be varied, the leveling can be achieved. Input voltages that are too high ($>$2V) or too low ($<$100 mV) are detected by comparing the lamp voltage at the limiting conditions--transistor Q25 detects the lamp off (or LOW) condition, and transistor Q19 detects the lamp fully on (or HIGH) condition. In the V mode, lamp driver is cut off by Q22 since the indicators are for 2H or 3H measurements only.

Preamplifier (Q4, Q5, and Q6) is preceded by attenuator R15 and R19 and switch Q8. The X10 attenuation is active only when the input voltage exceeds 1 V rms. For inputs equal to or less than this value, transistor switch Q8 is cut off for zero attenuation. In the V mode, FET switch Q7 switches the signal to the meter unit. In the 2H or 3H mode, Q17 switches the harmonic products to the meter unit, and Q19 provides the drive to the FET switches and opens up transistor switch Q7 to reduce the unwanted outputs of the V mode amplifier.

Executive Programming Circuit (Board A8)

Four gain lines come out of the Auto-Ranging Circuit: three are positive and one is negative. The positive lines are used for logic control; the negative line selects the desired gain. To override these automatic controls, the operator can set the METER RANGE front panel to one of four manual positions. Quad gates A1 serve as disable gates for the auto gain lines. Quad gates A2 are OR-gates that accept the input from the AUTO or MAN switch position. In the MAN position, the 30% local ranging (.003, .03, .3, and 3) is inhibited by Q23. This feature is desirable since the manual mode can be used to "freeze" the gain position in order to isolate faulty auto-ranging situations.

It can be seen in the table below that full-scale designations are different for the same gain setting in the two modes of operation.

V mode	2H or 3H	Gain
.01 V	1%	1000
.1 V	10%	100
1 V	100%	10
10 V	---	1

To coordinate the 100-to-1 offset in scale between the V mode and the 2H or 3H mode, transistors Q1-Q7 perform the mode selection to drive lamp encoder transistors Q11-Q15. Inputs to these transistors are designated .01 to 10 in four decade steps. The outputs of Q1-Q7 are OR'ed where needed to enable one of these decade steps.

Transistors Q16-Q24 drive the 100% full-scale lamps as shown in the lamp identification box in the schematic diagram. Transistors Q17-25 drive the 30% full-scale lamps. For 30% selection, a "1" appears on pin 7, which saturates Q27 to cutoff and Q16-Q24 via diodes to their bases. For 100% selection, Q26 is saturated and the 30% drivers are not enabled.

Remote Logic (Board A9)

This board provides the switching circuitry to disconnect the front panel controls and enable the remote digital control lines to (1) select the frequency band and measurement mode and (2) fine select the test frequency and test amplitude. In the latter two cases, the remote signals are 6-bit binary commands which are converted to analog voltages for fine selections of frequency and amplitude.

Multiple selector A7 selects four of the eight input lines as determined by the logic state of the selector control command on Pin 9. A logic level '1' enables all four of the A lines, thus allowing the remote control lines to operate; a logic '0' enables the B lines, which permits the front panel push buttons to operate. Note that the logic notations indicate that the complement of A is selected, whereas the B inputs aren't complemented.

For fine frequency and amplitude selection, the binary-coded digital control lines are first stored in latching buffers A1, A2, and A3. These latches follow or store the input levels, depending on the state of the latch control command input on Pins 4 and 13 off the latches. A positive level on the control line permits the latches to follow the input. The latch will store the input state at the moment of the last negative-going transition of the control line. If the remote source is a computer, the usual mode of operation is to set up the data lines for about 200 ns prior to a Data Ready Command, which strobes in the data.

The output of each set of six digital controls goes to current-switching transistors Q1 through Q6. Each switch controls the resistor return voltage so that a weighted current is switched in or switched out of the summing

mode at the inverting input to operational amplifier A4. The resistors are related in a binary manner and generate 64 discrete levels at the output of operational amplifier A5. The outputs of both A4 and A5 go to the remote selector switch mounted on the rear panel (S2).

In the remote position, the digital-to-analog converter replaces the front panel potentiometers that control the amplitude and frequency of the test oscillator. Since the pot levels are between 0.42 volt and 5.2 volts, the digital-to-analog output voltages are adjusted to these same voltage levels. The lower level (0.42 V) is established by returning the non-inverting input of the operational amplifier to 0.42 volt. The upper level is established by taking the product of the value of feedback resistor R26 (or 31) and the sum of all binary currents to be equal to 5.2 V. Since the 64 discrete levels are developed between these two limits, the level of each step is (5.2 - 0.42)/64.

± 18 V Power Supply, + 5.2 V Power Supply (Board A10)

CR1, CR2, CR3, and CR4 constitute a full-wave rectifier for the ± 18 V power requirements. The + 18 V line is regulated by A1 and adjusted by means of R3; Q1 is the pass element. The - 18 V line is regulated by Q3, Q4 and Q5 and adjusted by means of R13; Q6 is the pass element. This line is referenced to the + 18 V line through R12. Both the + 18 V and the - 18 V lines supply 600 mA.

The + 5.2 V line has its own transformer winding. It is rectified by CR5 and CR6, regulated by A2, and adjusted by means of R10. The pass element is Q2. This line supplies up to 1 amp of current for logic operation and also for driving the various lights in the instrument.

The power supply board A10 is transformer coupled to an a-c input of 110 V ± 10% at 48-400 Hz. Normal a-c power consumption is limited by means of a 1.0 amp fuse accessable from the rear of the instrument.

Input Amplifier Board A6

EQUIPMENT REQUIRED:

1. Signal Generator Wavetek 155 or equivalent
2. A-c rms voltmeter. H/P 400 El. or equivalent
3. Broad band oscilloscope Tektronics Model 454

CALIBRATION PROCEDURES:

1. Using External Oscillator apply to 101 IN Connector a 100 KHz 5 Vp-p square wave.
2. Observe with oscilloscope at test point 1 and adjust C2 on A6 for (least tilt) on square wave.
3. With External Oscillator set at 10 kHz vary amplitude from 100 mV to 2.0 Volts rms and adjust R64 for a constant Output at Pin No. 2 of 300 mV rms.
4. Proceed to A7 Calibration Instructions.
5. Set function to V, with shorted Input observe ranging to .003V full-scale range and note that preamplifier noise level is less than 1.2 mV as indicated on Meter M1.
6. Check accuracy of 10 V range, apply 10 V rms sine wave at 10 kHz R19 on A6 has been factory selected for 10 V $\pm$ 1%.

Low Pass Filter Board A4

EQUIPMENT REQUIRED:

1. Oscillator H/P 651 or equivalent
2. Rms Voltmeter H/P 400 El. or equivalent

CALIBRATION PROCEDURE:

1. Select Frequency Multiplier Band 100
2. Set Dial to '1'
3. Connect external sine wave oscillator to Pin No. 7 and com on A4 Board.
4. Connect rms voltmeter to Pin No. 21 of A4 Board and select 0 db scale
5. Adjust external oscillator to .16 of internal oscillator frequency (16 Hz) and set amplitude to 0 db on rms voltmeter by adjusting amplitude of external osc
6. Adjust external oscillator to .24 of Internal Oscillator Frequency (24 Hz)
7. Calibrate potentiometer R38 on A4 for -6 dB on rms voltmeter.
8. Set Dial to '10' on Direct Record Analyzer and repeat Steps 5 through 7.
9. Compromise R38 for '1' and '10' on Dial.
10. Repeat procedure for Bands 1K, 10K and 100K.
11. Differences between Band roll-off has been compensated for at the factory by selecting C7, C8, C9, C12.

Balanced Modulator Board A-5

EQUIPMENT REQUIRED:

1. Oscillator H/P 651, or equivalent
2. Oscilloscope Tektronics 453, or equivalent
3. Resistor Network consisting of 2 each 1K ohm, 1% metalfilm and 1 each 100 ohm, 1% metalfilm, RN60 style.
4. RMS Voltmenter H/P 400 EL, or equivalent

CALIBRATION PROCEDURE:

1. Solder all three resistors together to form a Tee network and connect the junction of the three resistors to the signal input connector. Connect the other side of the 100 ohm resistor to instrument common at the input BNC.
2. Connect the oscillator output BNC high to the unconnected end of one of the 1K resistors. Connect the unconnected end of the other 1K resistor to the external oscillator. Ground the external oscillator to the input BNC shield ground.
3. Using the RMS voltmeter, adjust the internal oscillator output to 3.0V $\pm$ 5mV at 500 Hz.
4. Using the RMS voltmeter, adjust the output of the external oscillator to 3.0V $\pm$ 5mV at 1.5KHz.
5. Depress the 3H pushbutton and set the meter range switch to manual 100% position.
6. Connect the oscilloscope to the high side of the input BNC. Vary the frequency of the external oscillator until a zero beat occurrs.
7. Decrease the output of the external oscillator by an exact factor of

7. (Continued)

   10, using the RMS voltmeter to verify calibration.

8. Select the manual 10% range and adjust potentiometer R22 on Board A5 until meter M1 reads 10% ± .5%.

9. Increase the external oscillator output to 3.0V RMS ± 5mV and set the range switch to manual 100%. Check that the meter reads 80% ± 10%. Some meter movement may be noticed, depending upon the frequency stability of the two oscillators.

10. Repeat the above procedure for Frequency Multiplier ranges of 1K, 10K and 100K, using calibration potentiometers R17, R11 and R9 respectively, increasing the frequency of the external oscillator accordingly. If oscillator frequency stability does not permit observing phase lock of the two oscillators at the higher frequencies, a frequency counter, H/P 5325A, or equivalent, may be used to determine an exact 3 to 1 frequency relationship.

SCHEMATIC REFERENCE	DESCRIPTION	PART NUMBER	MFR	QTY
Card No. 95-010040	LOW PASS FILTER A4			
A1	Integrated Circuit O.A. 741C	LM741C	NSC	1
C1,C2,C11,C16,C17,C20	C FXD 6.8 MFD 35V Tant	K6R8E35	Kemet	6
C3,C18,C23,C30,C34	C FXD 100 MFD 20V Tant	K100E20	Kemet	5
C4	C FXD .0082 MFD 50V 5% Myl	XP2A822J	IMB	1
C5	C FXD .082 MFD 50V 5% Myl	XP2A823J	IMB	1
C6	C FXD 33 MFD 20V Tant	K33E20	Kemet	1
C7	C FXD 220 pf 100V 5% S/M	SM110	GI	1
C8	C FXD .0022 MFD 50V 5% Myl	XP2A222J	IMB	1
C9	C FXD 0.82 MFD 50V 5% Myl	XP2A824J	IMB	1
C10	C FXD 820 pf 100V 5% S/M	SM110	GI	1
C12	C FXD .022 MFD 50V 5% Myl	XP2A223J	IMB	1
C13	C FXD 0.22 MFD 50V 5% Myl	XP2A224J	IMB	1
C14,C29	C FXD 10 pf 100V 5% S/M	SM110	GI	2
C15	C FXD .0012 MFD 50V 5% Myl	XP2A122J	IMB	1
C19	C FXD .012 MFD 50V 5% Myl	XP2A123J	IMB	1
C21	C FXD 0.12 MFD 50V 5% Myl	XP2A124J	IMB	1
C22	C FXD 1.0 MFD 35V 10% Tant C FXD .22 MFD 50V 5% Myl	K1E35 XP2A224J	Kemet IMB	1 1
C24	C FXD 10 MFD 35V Tant	K10E35	Kemet	1
C25	C FXD .0015 MFD 50V 5% Myl	XP2A152J	IMB	1
C26	C FXD .015 MFD 50V 5% Myl	XP2A153J	IMB	1
C27	C FXD 0.15 MFD 50V 5% Myl	XP2A154J	IMB	1

SCHEMATIC REFERENCE	DESCRIPTION	PART NUMBER	MFR	QTY
Card No.95-010040	LOW PASS FILTER (CONT.) A4			
C28	C FXD .0027 MFD 50V 5% Myl	XP2A272J	IMB	1
C31	C FXD .027 MFD 50V 5% Myl	XP2A273J	IMB	1
C32	C FXD 0.27 MFD 50V 5% Myl	XP2A274J	IMB	1
C33	C FXD 2.7 MFD 35V 10% Tant	K2R7E35	Kemet	1
C35	C FXD 150 pf 100V 5% S/M	SM110	GI	1
C36	C FXD 33 pf 100V 5% S/M	SM110	GI	1
CR1 thru CR18,CR20 thru CR31	Diode; IN3064	IN3064	F.S.	30
CR19	Diode; Zener, IN751A	IN751A	F.S.	1
L1,L2	Inductor; 100 micro Henry	1537-76	Delevan	2
P1,P2,P3,P4,P5	Part of Assy 10009-1	10009-1	CL1	5
PL1	Lamp; Part of Assy 10009-1	10009-1	CL1	1
Q1,Q3,Q22	TXSTR; NPN 2N2484	2N2484	F.S.	3
Q2,Q4,Q21	TXSTR; PNP 2N4250	2N2450	F.S.	3
Q5 thru Q15, Q17 thru Q20	TXSTR; NPN 2N2222	2N2222	F.S.	15
Q16	TXSTR; PNP 2N4126	2N4126	F.S.	1
R1,R4,R5,R6,R11,R14, R49,R50,R51	R; FXD 1K 5% 1/4W Comp	010231	AB	9

SCHEMATIC REFERENCE	DESCRIPTION	PART NUMBER	MFR	QTY
Card No. 95-010040 LOW PASS FILTER (CONT.) A4				
R2,R7,R8,R10,R12,R15, R66	R FXD 100K 5% 1/4W Comp	010431	AB	7
R3,R9,R13,R25,R48,R52	R FXD 1K 1% 1/4W M.F.	RN60D1001	IRC	6
R16,R17,R18,R19	R FXD 33K 5% 1/4W Comp	033331	AB	4
R20	R FXD 68 ohms 5% 1/4W Comp	068031	AB	1
R21,R32	R FXD 12K 5% 1/4W Comp	012331	AB	2
R22,R27,R53	R FXD 270K 5% 1/4W Comp	027431	AB	3
R23,R57,R58,R60,R62	R FXD 330K 5% 1/4W Comp	033431	AB	5
R24	R FXD 10K 1% 1/4W M.F.	RN60D1002	IRC	1
R26,R40,R42	R FXD 10K 5% 1/4W Comp	010331	AB	3
R28,R31,R34,R36,R54, R56,R59,R61,R64	R FXD 2.7K 5% 1/4W Comp	027231	AB	9
R29,R43	R FXD 2.2K 5% 1/4W Comp	022231	AB	2
R30,R55	R FXD 680 ohms 5% 1/4W Comp	068131	AB	2
R33,R35	R FXD 47K 5% 1/4W Comp	047331	AB	2
R37	R FXD 150K 5% 1/4W Comp	015431	AB	1
R38	R VAR 20K S.T. Cermet	3329P203	Bourns	1
R39,R63	R FXD 22K 5% 1/4W Comp	022331	AB	2
R41,R45,R67	R FXD 1.8K 5% 1/4W Comp	018231	AB	3
R44,R46	R FXD 330 5% 1/4W Comp	033131	AB	2
R47	R FXD 560 5% 1/4W Comp	056131	AB	1
R65	R FXD 10 ohms 5% 1/4W Comp	010031	AB	1

SCHEMATIC REFERENCE	DESCRIPTION	PART NUMBER	MFR	QTY
Card No. 95-010050	BALANCED MODULATOR A5			
A1	I.C. MC1596C7 Balanced Modulator	MC1596G	Signetics	1
C1	C.F. 0.47 MFD 50V 5% Myl	XP2A474J	IMB	1
C2,C3,C9	C.F. 33 MFD 20V Tant	K33E20	Kemet	3
C4,C5	C.F. 100 MFD 20V Tant	K100E20	Kemet	2
C6	C.F. 6.8 MFD 35V Tant	K6R8E35	Kemet	1
C7	C.F. 150 pfd 100V 5% S/M	SM110	GI	1
C8	C.F. 2.2 MFD 35V Tant	K2R2E35	Kemet	1
CR1	Diode: Zener, IN756A, 8.2V	IN756A	FS	1
CR2,CR3,CR4,CR5	Diode: IN3064	IN3064	FS	4
CR6	Diode: Zener, IN759A, 12V	IN759A	FS	1
L1	Inductor: 100 micro Henry	1537-76	Delevan	1
Q1,Q2,Q3,Q4,Q5	TXSTR: 2N2222 NPN	2N2222	FS	5
Q6	TXSTR: 2N2484 NPN	2N2484	FS	1
Q7	TXSTR: 2N4250 PNP	2N4250	FS	1
R1,R2,R3,R4,R18,R14, R19,R20	R.F. 1K ohms 5% 1/4W Comp	010231	AB	8
R5	R.F. 82K ohms 5% 1/4W Comp	082331	AB	1

SCHEMATIC REFERENCE	DESCRIPTION	PART NUMBER	MFR	QTY
Card No. 95-010050	BALANCED MODULATOR A5			
R6	R.F. 100K ohms 5% 1/4W Comp	010431	AB	1
R7	R.F. 22 ohms 5% 1/4W Comp	022031	AB	1
R9,R11,R17,R22	R.V. 2K ohms S.T. 1W Cermet	3329P201	Bourns	4
R10,R13,R15,R16,R31	R.F. 100 ohms 5% 1/4W Comp	010131	AB	5
R12,R18	R.F. 330 ohms 5% 1/4W Comp	033131	AB	2
R21	R.F. 560 ohms 5% 1/4W Comp	056131	AB	1
R23	R.F. 6.8K ohms 5% 1/4W Comp	068231	AB	1
R24,R25	R.F. 3.9K ohms 5% 1/4W Comp	039231	AB	2
R26	R.F. 100K ohms 1% 1/4W M.F.	RN60D1003	IRC	1
R28	R.F. 12K ohms 5% 1/4W Comp	012331	AB	1
R29	R.F. 2.49K ohms 1% 1/4W M.F.	RN60D2491	IRC	1
R27	R.F. 33.2K 1% 1/4W M.F.	RN60D3322	IRC	1
R30	R.F. 1.2K 5% 1/4W Comp	012231	AB	1
R32	R.F. 1.5K 1% 1/4W M.F.	RN60D1501	IRC	1

SCHEMATIC REFERENCE	DESCRIPTION	PART NUMBER	MFR	QTY
Card No. 95-010060 INPUT AMPLIFIER A6				
A1	I.C. O.A. 741C	LM74IC	NSC	1
C1	C FXD 0.1 MFD 50V 5% Myl	XP2A104J	IMB	1
C2	C VAR 2.5-7 pf			1
C3,C4	C FXD 2 pf 100V ± 5 pf S/M	SM110	GI	2
C5	C FXD 10 MFD 35V Tant	K10E35	Kemet	1
C6	C FXD 100 MFD 20V Tant	K100E20	Kemet	1
C7,C20	C FXD 0.1 MFD 100V Disc Cer	MAG2511	GI	2
C8,C10,C13,C17,C18, C19,C24,C25,C26,C27	C FXD 33 MFD 20V Tant	K33E20	Kemet	10
C9,C28	C FXD 330 MFD 6V Tant	K330E6	Kemet	2
C11	C FXD 180 pf 100V 5% S/M	SM110	GI	1
C12,C20,C22,C23	C FXD 6.8 MFD 35V Tant	K6R8E35	Kemet	4
C14	C FXD 1.0 MFD 35V 10% Tant	K1E35	Kemet	1
C15,C16	C FXD 120 pf 100V 5% S/M	SM110	GI	2
CR1 thru CR10	Diode IN3064	IN3064	FS	10
CR11	Diode IN270	IN270	FS	1
L1,L2	Inductor 100 micro Henry	1537-76	Delevan	2
L3	Inductor 10 micro Henry	1537-36	Delevan	1
LP1	Part of PI Assembly		VT6005	1
LP2	Lamp 6.8V 40 mA "O.R."	683	Rodan	1

SCHEMATIC REFERENCE	DESCRIPTION	PART NUMBER	MFR	QTY
Card No. 95-010060 INPUT AMPLIFIER (CONT.) A6				
P1	Photo Conductor VT6005	VT6005	Vactec	1
Q1	TXSTR 'P' TYPE 2N4303	2N4303	F.S.	1
Q2,Q4,Q5,Q8,Q10,Q11, Q13,Q15,Q18,Q19	TXSTR NPN 2N4275	2N4275	F.S.	10
Q3,Q6,Q12,Q14,Q16	TXSTR PNP 2N4126	2N4126	F.S.	5
Q7,Q17	TXSTR FET 'P' TYPE P1086	P1086	Amelco	2
Q9,Q21,Q22	TXSTR NPN 2N2222	2N2222	F.S.	3
Q20	TXSTR PNP 2N4125	2N4125	F.S.	1
R1	R FXD 665K 1% 1/4W M.F.	RN60D6654	IRC	1
R2,R10,R21,R31,R57, R62,R73	R FXD 10K 5% 1/4W Comp	010331	AB	7
R3	R FXD 348K 1% 1/4W M.F.	RN60D3484	IRC	1
R4,R46	R FXD 100 ohms 5% 1/4W Comp	010131	AB	2
R5	R FXD 200 ohms 5% 1/4W Comp	020131	AB	1
R6,R22,R29,R42,R49, R59	R FXD 270 ohms 5% 1/4W Comp	027131	AB	6
R7,R39,R77	R FXD 3.3K 5% 1/4W Comp	033231	AB	3
R8,R47	R FXD 2.2K 5% 1/4W Comp	022231	AB	2
R9	R FXD 51 ohms 5% 1/4W Comp	051031	AB	1
R11	R FXD 470K 5% 1/4W Comp	047431	AB	1
R12,R17,R24,R34,R40	R FXD 3.9K 5% 1/4W Comp	039231	AB	5
R13	R FXD 56 ohms 5% 1/4W Comp	056031	AB	1

SCHEMATIC REFERENCE	DESCRIPTION	PART NUMBER	MFR	QTY
Card No. 95-010060 INPUT AMPLIFIER (CONT.) A6				
R14	R FXD 1K 5% 1/2W Comp	010233	AB	1
R15,R16	R FXD 2K 1% 1/4W M.F.	RN60D2001	IRC	2
R18,R32,R56	R FXD 18K 5% 1/4W Comp	018331	AB	3
R19	R FXD 221 ohms 1% 1/4W M.F.	RN60D2210	IRC	1
R20	R FXD 8.2K 5% 1/4W Comp	082231	AB	1
R23	R FXD 390 ohms 5% 1/4W Comp	039131	AB	1
R25	R FXD 1.82K 1% 1/4W M.F.	RN60D1821	IRC	1
R26,R44	R FXD 1K 1% 1/4W M.F.	RN60D1001	IRC	2
R27	R VAR 200 ohms 1W S.T. Cermet	3329P201	Bourns	1
R28,R48,R69,R71	R FXD 1.8K 5% 1/4W Comp	018231	AB	4
R30	R FXD 100K 5% 1/4W Comp	010431	AB	1
R33	R FXD 33K 5% 1/4W Comp	033331	AB	1
R35,54	R FXD 1K 5% 1/4W Comp	010231	AB	2
R36	R FXD 150K 5% 1/4W Comp	015431	AB	1
R37	R FXD 10 ohms 5% 1/4W Comp	010031	AB	2
R38,R78	R FXD 6.8K 5% 1/4W Comp	068231	AB	2
R41,R61,R63,R76	R FXD 4.7K 5% 1/4W Comp	047231	AB	4
R43	R FXD 12K 5% 1/4W Comp	012331	AB	1
R45	R FXD 10K 1% 1/4W M.F.	RN60D1002	IRC	1
R50	R FXD 22 ohms 5% 1/4W Comp	022031	AB	1
R51	R FXD 220 5% 1/4W Comp	022131	AB	1
R52	R FXD 22K 5% 1/4W Comp	022331	AB	1
R53	R FXD 4.99K 1% 1/4W M.F.	RN60D4991	IRC	1

SCHEMATIC REFERENCE	DESCRIPTION	PART NUMBER	MFR	QTY
Card No. 95-010060 INPUT AMPLIFIER (CONT.) A6				
R55,R74	R FXD 2.7K 5% 1/4W Comp	027231	AB	2
R58,R72	R FXD 560 ohms 5% 1/4W Comp	056131	AB	2
R60	R FXD 390K 5% 1/4W Comp	039431	AB	1
R64	R VAR 2K S.T. Cermet	3329P202	Bourns	1
R65	R FXD 100K 1% 1/4W M.F.	RN60D1003	IRC	1
R66	R FXD 47K 5% 1/4W Comp	047331	AB	1
R67	R FXD 3.48K 1% 1/4W MF	RN60D3481	IRC	1
R68,R70	R FXD 330 ohms 5% 1/4W Comp	033131	AB	2
R75	R FXD 470 ohms 5% 1/4W Comp	047131	AB	1

SCHEMATIC REFERENCE	DESCRIPTION	PART NUMBER	MFR	QTY
Card No. 95-010080 EXECUTIVE PROGRAMMER A8				
A1	I.C. SP348A	SP348A	Signetics	1
A2	I.C. SN7400N Quad Nand Gate	SN7400N	TI	1
C1	C.F. 330 MFD 6V Tant	K330E6	Kemet	1
CR1,CR2,CR11,CR12, CR13	Diode: IN3064	IN3064	F.S.	5
CR3,CR4,CR5,CR6,CR7, CR8,CR9,CR10,CR14, CR15	Diode: IN270 Ger.	IN270	F.S.	10
J2	Connector, Male 20 Pin	3428	3M Co.	1
LP1 thru LP20	Part of Lamp Board Assy 95-010140	95-010140	CLI	20
Q1,Q2,Q3,Q4,Q5,Q6,Q7, Q8,Q9,Q10,Q16,Q17, Q18,Q19 thru Q31	TXSTR: 2N2222 NPN	2N2222	F.S.	26
Q11,Q12,Q13,Q14,Q15	TXSTR: 2N4126 PNP	2N4126	F.S.	5
R1	R.F. 2.7K ohms 5% 1/4W Comp	027231	AB	1
R2,R3,R4,R5,R31	R.F. 10K ohms 5% 1/4W Comp	010331	AB	5
R6,R8	R.F. 3.3K ohms 5% 1/4W Comp	033231	AB	2
R7,R9,R14	R.F. 820 ohms 5% 1/4W Comp	082131	AB	3

SCHEMATIC REFERENCE	DESCRIPTION	PART NUMBER	MFR	QTY
Card No. 95-010080	EXECUTIVE PROGRAMMER (CONT.)	A8		
R10,R34	R.F. 1K ohms 5% 1/4W Comp	010231	AB	2
R11	R.F. 1.8K ohms 5% 1/4W Comp	018231	AB	1
R13,R33	R.F. 10 ohms 5% 1/4W Comp	010031	AB	2
R15,R32	R.F. 220 ohms 5% 1/4W Comp	022131	AB	2
R16,R17,R18,R19,R20, R21,R22,R23,R24,R25	R.F. 2.2K ohms 5% 1/4W Comp	022231	AB	10
R26,R27,R29	R.F. 2.2K ohms 5% 1/4W Comp	015231	AB	3
R28	R.F. 560 ohms 5% 1/4W Comp	056131	AB	1
R30	R.F. 4.7K ohms 5% 1/4W Comp	047231	AB	1

SCHEMATIC REFERENCE	DESCRIPTION	PART NUMBER	MFR	QTY
Card No. 95-010090	REMOTE LOGIC A9			
A1,A2,A3	I.C. SN7475N	SN7475N	TI	3
A4,A5	I.C. LM741C OA	LM741C	NSC	2
A6,A7	I.C. N8267B	N8267B	Signetics	2
C1	C.F. 330 MFD 6V Tant	K330E6	Kemet	1
C2	C.F. 33 MFD 20V Tant	K33E20	Kemet	1
CR1 thru CR20	Diode IN3064	IN3064	FS	20
J1	Connector Part Of Assy 95-012090	95-012090	CLI	1
Q1 thru Q12	TXSTR, 2N4126 PNP	2N4126	FS	12
R1	R.F. 1.5K ohms 5% 1/4W Comp	015231	AB	1
R2,R8	R.F. 6.8K ohms 5% 1/4W Comp	068231	AB	2
R3,R9	R.F. 3.9K ohms 5% 1/4W Comp	039231	AB	2
R4,R10	R.F. 1.8K ohms 5% 1/4W Comp	018231	AB	2
R5,R11,R40	R.F. 1K ohms 5% 1/4W Comp	010231	AB	3
R6,R12	R.F. 470 ohms 5% 1/4W Comp	047131	AB	2
R7,R13,R28,R29,R34,R36	R.F. 330 ohms 5% 1/4W Comp	033131	AB	6
R14,R20	R.F. 140K 1% 1/4W M.F.	RN60D1403	IRC	2

SCHEMATIC REFERENCE	DESCRIPTION	PART NUMBER	MFR	QTY
Card No. 95-010090	REMOTE LOGIC (CONT.) A9			
R15,R21	R.F. 69.8K 1% 1/4W M.F.	RN60D6982	IRC	2
R16,R22	R.F. 34.8K 1% 1/4W M.F.	RN60D3482	IRC	2
R17,R23	R.F. 17.4K 1% 1/4W M.F.	RN60D1742	IRC	2
R18,R24	R.F. 8.66K 1% 1/4W M.F.	RN60D8661	IRC	2
R19,R25	R.F. 4.32K 1% 1/4W M.F.	RN60D4321	IRC	2
R26,R31	R.F. 604 ohms 1% 1/4W M.F.	RN60D6040	IRC	2
R27,R33	R.F. 4.7K ohms 5% 1/4W Comp	047231	AB	2
R30,R35	R.F. 150 ohms 5% 1/4W Comp	015131	AB	2
R32,R42	R.F. 390 ohms 5% 1/4W Comp	039131	AB	2
R37	R.F. 2.2K ohms 5% 1/4W Comp	022231	AB	1
R38	R.F. 5.6K ohms 5% 1/4W Comp	056231	AB	1
R39	R.F. 560 ohms 5% 1/4W Comp	056131	AB	1
R41	R.F. 820 ohms 5% 1/4W Comp	082131	AB	1
S2	Switch;Slide,3 Pole 2 Pos Rear Pnl		Stackpole	1

SCHEMATIC REFERENCE	DESCRIPTION	PART NUMBER	MFR	QTY
Card No. 95-010100	POWER SUPPLY A10			
A1,A2	I.C.; 723C Voltage Regulator	723C	F.S.	2
C1,C2	C.F. .005 MFD 500V Disc Cer	TA250	GI	2
C3,C5	C.F. 2100 MFD 30Vdc Alum	39D218G030H54	SPG	2
C4	C.F. 4000 MFD 15Vdc Alum	39D408G025JT4	SPG	1
C6	C.F. .002 MFD 100V Disc Cer	TA220	GI	1
C7	C.F. .01 MFD 100V Disc Cer	MAG 2511	GI	1
C8	C.F. .001 MFD 5% 100V S/M	SM110	GI	1
C9	C.F. 75 MFD 30 Vdc Alum	39D756G030EE4	SPG	1
CR1,CR2,CR3,CR4,CR5, CR6	Diode; IN4003	IN4003	F.S.	6
CR7,CR8	Diode; IN3064	IN3064	F.S.	2
F1	Fuse; 3AG 3/4 Amp Slo Blo	3AG3/4A	Little Fuse	1
L1,L2	Inductor; 56 micro Henry 300 M.A.		Miller	2
Q1,Q2,Q6	TXSTR; PWR 2N3055 PNP	2N3055	RCA	3
Q3,Q4	TXSTR; 2N4125 PNP	2N4125	F.S.	2
Q5	TXSTR; 2N2905 PNP	2N2905	F.S.	1
R1,R16	R.F. 0.82 ohms 10% 1W WW	082-243	AB	2

SCHEMATIC REFERENCE	DESCRIPTION	PART NUMBER	MFR	QTY
Card No. 95-010100	POWER SUPPLY (CONT.) A10			
R2	R.F. 3.9K ohms 5% 1/4W Comp	039231	AB	1
R3	R.V. 1K S.T. 1W Cermet	3329P102	Bourns	1
R4,R11	R.F. 2.2K 5% 1/4W Comp	022231	AB	2
R5	R.F. 330 ohms 10% 1W Comp	033143	AB	1
R6,R17	R.F. 100 ohms 5% 1/4W Comp	010131	AB	2
R8	R.F. 0.33 ohms 10% 1W WW	033-243	AB	1
R9	R.F. 680 ohms 5% 1/4W Comp	068131	AB	1
R10,R13	R.F. 500 ohms S.T. 1W Cermet	3329P501	Bourns	2
R12	R.F. 6.2K ohms 5% 1/4W Comp	002231	AB	1
R14	R.F. 5.6K ohms 5% 1/4W Comp	056231	AB	1
R15	R.F. 470 ohms 5% 1/4W Comp	047131	AB	1
R18,R19	R.F. 3.3K ohms 5% 1/4W Comp	033231	AB	2
S1	Switch:Push Button DPDT Fnt. Panl. Cnl.	1-EE	IEE	1
T1	Transformer Power #14C2	FR14C2	F&R	1

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